TRANSACTIONS

OF THE

NEW YORK ACADEMY OF SCIENCES.

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OF THE

NEW YORK ACADEMY OF SCIENCES

LATE

LYCEUM OF NATURAL HISTORY.

VOLUME XI.

October, 1891, to June, 1892.

Edited by the Recording Secretary, assisted by the Publication Committee.

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1892–1893.

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TRANSACTIONS

OF THE

NEW YORK ACADEMY OF SCIENCES.

October 5th, 1891.

REGULAR BUSINESS MEETING.

Vice-President, DR. HUBBARD, in the chair. About twenty-five persons present.

The Recording Secretary read the minutes of June 1st, which were adopted.

DR. N. L. BRITTON stated that since the lamentable death of DR. JOHN I. NORTHROP he had acted as Librarian, and with the aid of officers of the Columbia College Library had perfected a scheme for recording volumes received; that the library of the Academy had acquired a substantial addition during the recess, amounting to about 1000 parts of volumes.

The Recording Secretary referred to the tragic death of DR. NORTHROP and nominated DR. H. T. VULTÉ to fill the vacancy in the librarianship.

The following persons were nominated for Resident Members:—

MR. DEWITT J. APGAR,	by CAPT. THOMAS L. CASEY.
MR. GEORGE H. KNIGHT,	by PROF. J. K. REES.
MR. NELSON SMITH,	by H. CARRINGTON BOLTON.
MR. J. PIERPONT MORGAN,	" " "
MR. WM. C. SCHERMERHORN,	" " "
DR. CLARK BELL,	by MRS. ANNIE CHAMBERS KETCHUM.
MISS VIRGINIA VAUGHAN,	" " " "
MRS. EDWARD HEYLYN,	" " " "
MR. ERNEST DU VIVIER,	by WM. G. DE WITT.
PROF. JAMES F. KEMP,	by DR. N. L. BRITTON.

Mr. Arthur Hollick,	by N. L. Britton.
Mr. Ernest Lederle,	" " "
Mr. Heinrich Ries,	" " "

And the following as Corresponding Members: José G. Aguilera, of Mexico City, and Prof. L. Clerc, of Ekaterinburg, Russia; both by Mr. George F. Kunz.

The Secretary read a letter from Dr. Eugen Sell, of Berlin, announcing that Prof. A. W. Hofmann would celebrate the jubilee of his doctorate on August 9th, 1891. Dr. Bolton stated that by chance he was in Berlin and assisted at the pleasant ceremonial.

The Secretary read the following paper by title:—

Coleopterological Notices, No. III.

BY THOMAS L. CASEY.

[This paper will be published in the Annals, Vol. VI, Nos. 2 and 3.]

The Secretary announced that he had received a copy of the will of Mme. Anne Emilie Clara Goguet, widow of Monsieur Marc Guzman, who died at Pau, France, in the Convent of l'Espérance, June 30th, 1891. By this will the New York Academy is to receive a legacy of 100,000 francs, provided two other institutions decline the conditions; these institutions are, first, the Academy of Sciences, Paris, and, second, the Academy of Sciences at Milan. The conditions are peculiar, viz.: the sum named to be awarded as a prize to the person who succeeds in communicating with one of the planets and receiving a reply, the planet Mars being excepted as it is sufficiently well known. A second clause, however, names conditions which are more easily fulfilled, and it is highly improbable that the New York Academy of Sciences will receive the legacy. The will is here given in full in the original language.

TESTAMENT DE MAD^{e} VEUVE GUZMAN.

I.

Enveloppe renferment le testament.

Ceci est mon testament que je prie Mess Mallet de garder dans leur caisse, et de remettre en temps et lieux (à mon décès) à M. le Colonel Floridor Dumas, 11 rue des Beaux Arts, et à M. De la Palme, notaire, 15 rue de la chaussee d'Antin.

Anne Emilie Clara Goguet, V^{e} Guzman.

Paris, 30 Octobre, 1889.

II.

Lettre accompagnant le testament.

Pau, 1er Mars, 1889.
Couvent des Sœurs de l'Espérance,
rue Monpensier 9.

Je dis que le testament que je joins à cette lettre et daté du 11 et 18 Décembre, mil huit cent quatre-vingt huit est le seul valable. Je le confie au Colonel Floridor Dumas que je nomme mon executeur testamentaire.

Résumé des legs que je fais.

A l'académie des sciences de l'Institut de France	100,000
A l'académie de médecine de Paris	50,000
A l'assistance publique	50,000
A Pierre Carnoy, filleul de mon fils	30,000
A Jeanne et Réné Garcin, petits enfants d'Antoine Garcin, en son vivant, boulevard Bonne nouvelle 26	4,000
Sœur Rosalie 2000, (Delort Cornélie) 2000	4,000
Rente Goiraud fond 4000, Messes 4000 à Vannes	8,000
Emile Leclert 10,000, Colonel Dumas 10,000	20,000
Notaire et clerc 6000, frais 6000	12,000
	278,000
Ville de Vannes	10,000

Donc il me semble que j'ai disposé de deux cent quatre-vingt huit mille francs, auquels il faut ajouter à peu pres dix mille francs pour frais de maladie, enterrement, etc. Or je laisse en rente

3 % plus de	9,210	rente
Ville de Paris	72	
Avec moi en certificats nominatif Foncières, Ouest, Orleans, plus de	1,200	de rente
Chez messieurs Mallet	2,000	" "
" " Hottinguer	700	" "
rente	12,982	

J'ai oublié dans les dépenses le coût des insertions que je demande dans les journaux.

J'ai fait le plus équitablement que j'ai pu.

Adieu colonel Dumas.

A. E. C. Goguet, Ve Guzman.

Il faut compter que j'ai aussi 5 actions, canal de Suez.

J'obligations item, Anne E. C. Goguet, Ve Guzman, le 28 Sept. 1890.

En suite se trouve cette mention :

Enregistré à Paris, premier bureau, le dix Juillet, mil huit cent quatre-vingt onze, folio 35, case 15; reçu pour enregistrement sept francs cinquante centimes, amende de timbre cinquante francs, décimes quatorze francs trente huit centimes.

Total: Soixante onze francs quatre-vingt huit centimes.

Signé: JENTY.

III.

Testament.

Paris, ce 11 Décembre, mil huit cent quatre-vingt huit.

J'annulle et révoque tout testament, toute donation fait avant le présent écrit, que je déclare être ma dernière volonté.

J'institue M. le Colonel Floridor Dumas, 11 rue des Beaux Arts à Paris, mon légataire universel, à la condition bien entendu qu'avant tout, les legs et dispositions que je fais ci-après seront executés et remplis.

Je lègue à l'académie des Sciences de l'Institut de France cent mille francs pour fonder un prix qui portera le nom de mon fils Pierre Guzman; ce prix sera donné sans exclusion de nationalité à celui qui trouvera le moyen de communiquer avec un astre et reçevoir réponse à ce signe. J'exclus la planète Mars qui parait suffisament connue.

Tant que la solution demandé ne sera pas obtenue, les intérêts seront cumulés pendant cinq années et formeront un prix toujours décerné sous le nom de mon fils, à un savant français ou étranger, qui aura fait faire un progrès réel et sérieux, soit dans la connaissance intime des planètes de notre système polaire, soit dans les relations des planètes de ce système avec la terre au moyen d'instruments de physique ou d'optique plus perfectionnés ou par tout autre moyen de mode d'inspection ou d'investigation.

Si les prix ne seront pas décernés au bout de dix ans, l'Académie aura le droit de donner deux prix sous le nom de mon fils et dans les mêmes conditions avec les intérêts du capital.

Je lègue cinquante mille francs à l'académie de médecine de Paris pour fonder un prix qui portera le nom de mon fils Pierre Guzman et qui sera donné à celui qui trouvera un traitement réellement efficace dans les formes les plus communes dans les maladies organiques du cœur confirmées.

En attendant qu'on vienne à trouver s'il se peut un traitement qui guérisse la plus part de ces maladies, je veux que la rente de ces cinquante mille francs soit décernée chaque année au travail théorique ou pratique le meilleur sur l'une ou l'autre de ces maladies.

Je lègue cinquante mille francs à l'assistance publique pour que l'on fasse chaque semaine dans les établissements de Ste. Périnne, d'Ivry et des Petits ménages une musique militaire comme celle qui se fait dans les jardins publics de Paris. La musique devra durer pendant une heure au moins, et être faite dans les cours au jardins de ces établissements et non dans la rue. Si avec la rente de ces cinquante mille francs, il y a de quoi faire de la musique dans un autre établissement je veux que ce soit dans un établissement de vieillards.

Aussitôt l'ouverture de mon testament je veux que les trois dispositions et legs que je fais ci-dessus soient annoncés dans des journaux compétents; deux journaux français, deux journaux espagnols, un journal anglais, et un journal américain "le New York Hérald," les annoncés seront faites une fois tous les ans à la même époque pendant 10 ans si les prix ne sont pas décernés jusque là. Le coût en sera prélevé sur l'actif de ma succession sans que la mort ou la négligence de mon légataire universal puisse les interrompre.

Je légue trente mille francs à Pierre Carnoy, le filleul de mon fils et fils de Marie Roy et de Ferdinand Carnoy ingénieur à Lorient. Ces trente mille francs seront placés en 3% français et déposés à la caisse des dépôts et consignations pour lui être remis à sa majorité. Les intérêts seront employés jusque là pour faciliter ses Etudes pour entrer à l'Ecole Polytecnique.

Je légue quatre mille francs pour être partagés entre Jeanne Garcin et Réné Montagnon petits enfants de feu Antoine Garcin avocat, demeurant en son vivant 26, boulevard Bonne nouvelle.

Je légue deux mille francs à sœur Rosalie, dominicaine au couvent rue de la Nostre à Pau, en souvenir des soins qu'elle a donnés à mon fils.

Je légue deux mille à Mdlle Cornélie Delort, rue Ste. Ferdinand 20 à Paris, fille du général Delort.

Je légue deux cent francs de rente à Mme. Goiraud, propriétaire à Versailles rue Satory 12, reversibles sur la tête de sa nièce Mme. Raisin pour entretenir toujours en parfait étât, le tombeau dont elles ont bien voulu prendre soin jusqu'ici et ou reposent ma mère, ma sœur et mon fils. Le coût pour que je sois enterré dans ce même tombeau sera prélevé sur l'actif de ma succession.

Je légue deux mille francs à la fabrique de la cathédrale de Vannes, Morbihan, pour qu'il soit célébré tous les ans une grande messe anniversaire le jour de le mort de mon fils (nuit du 7 et 8 Mai 1886). Aussi deux mille francs pour qu'il soit également célébré une grande messe le 9 Novembre tous les ans pour les anniversaires de la mort de ma mère et de ma sœur. Il est entendu que ces grandes messes seront célébrés dans la cathédrale de Vannes même et non ailleurs.

Je légue six mille francs à M. De la Palme, notaire, 15 rue de la chaussée d'Antin, dont trois des ces six mille francs pour son 1er clerc M. Ribaut (en tout six mille).

Tous les legs que je fais ci-dessus au dessus de deux mille francs payeront leurs droits, et ma succession n'en sera pas grevée.

Mons fils a chargé M. Emile Leclert, ingenieur 75 rue de Chaillot, de la suite de ses travaux scientifiques. Dès que M. Emile Leclert aura fait paraitre; dès que M. Emile Leclert aura fait paraitre un résultat définitif (concernant le Dynamoteur et l'aviation) en l'honneur de mon fils avec quelques pages explicatives toujours en l'honneur de mon fils, je lui lègue dix mille francs, dont cinq mille pour les frais et cinq mille pour lui.

M. le Colonel Floridor Dumas, 11 rue des Beaux Arts à Paris, lequel je nomme mon executeur testamentaire, s'est chargé de publier à mon nom les manuscrits personels que je laisse qui composent trois volumes, un conte de fées, un roman Corallé episode de la revolution de St. Domingue, un morceaux detachés et poesies; dès que ces trois volumes seront publiés je lui lègue dix mille francs dont cinq mille pour les frais et cinq mille pour lui.

Le travail de M. Emile Leclert et celui du Colonel Dumas terminés, l'argent que je leur lègue leur sera compté et jusqu'à ce travail fini l'argent sera déposé à la caisse des dépôts et consignations.

Je lègue tout ce qu'il y a de tableaux et minatures chez moi au filleul de mon fils, pour que le tout lui soit conservé jusqu'à sa majorité. Je lui lègue aussi tous mes bijoux.

Je lègue mon mobilier, linge de corps et de maison, glaces, pendules, garniture de cheminées, vaisselle, argenterie à l'hospice de la ville de Vannes (hospice militaire s'il est possible). Je lui lègue aussi les atlas, tous les livres, brochures, qui se sont dans la bibliothèque. Je fais ce lègue à la condition que la ville de Vannes ne vende rien de ce que je lui laisse, absolument rien, mais fasse emporter le tout à Vannes.

Si un ou plusieurs legs que je fais ne sont pas acceptés dans les propres termes que j'ai dit, ce leg ou ces legs seront donnés à l'académie des sciences de Milan, pour recompenser celui qui trouvera le moyen de correspondre avec un astre (je veux dire faire un signe à un astre et recevoir répons à ce signe) si l'académie des sciences de Milan refuse, je la remplace par l'académie des sciences de New York, Etats Unis d'Amérique.

Paris, ce 30 Juillet mil huit cents quatre-vingt neuf.

Anne Emilie Clara Goguet, V^{e} Guzman.

C'est entendu, ce testament est ma dernière volonté.

Paris, ce 30 Juillet mil huit cents quatre-vingt neuf.

Anne Emilie Clara Goguet, V^{e} Guzman.

En marge de ce testament se trouvé cette mention : Enregistré à Paris, premier bureau, le dix Juillet mil huit cents quatre-vingt onze, folio 35, case 14, reçu neuf francs trente huit centimes, décimes compris. (Signé) JEANTY.

Il est ainsi aux originaux des enveloppe, lettre et testament olographes ci-dessus littéralement transcrit, de Mad^{e} Anne Emilie Clara Goguet en son vivant sans profession veuve de M. Marc Guzman dé édée à Pau au convent de l'Esperance, rue Montpensier, le trente Juin mil huit cent quatre-vingt onze.

Lesd. lettre et testament déposés au rang des minutes de M. Emile De la Palme, notaire à Paris soussigné le deux Juillet mil huit cent quatre-vingt onze, en vertu d'un ordonnance rendue par l'un de Messieurs les Juges pour M. le Président du tribunal civil de première instance de la Seine, contenue en son procès verbal d'ouverture et de description des d. lettre et testament en date du même jour enregistrés. DE LA PALME.

The Chairman then called on members for communications. DR. BRITTON stated that in continuation of his study of South American plants he had examined the herbaria preserved at Kew, Paris, and Geneva. He had also studied the old types as seen in the Linnæan Collection at Burlington House, and those of Jussieu and Lamark at Paris, and of de Candolle at Geneva. The results were chiefly of a technical nature and would be given on another occasion.

PROF. D. S. MARTIN spoke of having attended the three great scientific meetings at Washington, details of which he reserved for the future.

MR. GEORGE F. KUNZ spoke of mineralogical observations made by him in Bohemia, in the Ural Mountains at the platinum washings, etc.

MR. A. L. RAWSON spoke of a visit to the supposed wall near Cleveland, Tenn., and stated that it had not been determined whether the wall is natural or artificial. The wall is about one thousand feet long, built in three courses of sandstone about eight feet high, and rests on sandstone. The courses are joined with a red cement not easily separated. Between two courses are strange characters resembling inscriptions cut by man, and the speaker exhibited a sketch of a portion of these characters.

DR. BRITTON asked if the markings were in relief, and MR. RAWSON, by the aid of the blackboard, explained the position and nature of the so-called characters.

DR. BOLTON referred to the fact that alkaline solutions, especially calcareous, sometimes infiltrate sandstones and produce peculiar forms in attempting to crystallize out in the pores, imitating the work of man.

MR. KUNZ referred to the quartz markings on septaria.

DR. BOLTON being called upon by the Chair, stated he had been engaged in bibliographical studies abroad, especially in the libraries of London, Paris, Strassburg, Darmstadt, and Berlin. He praised the advantages offered scholars at the British Museum, and spoke of the unsatisfactory arrangements at the Bibliothèque Nationale, Paris. He had experienced courtesies everywhere.

The Secretary announced the presence of PROF. F. R. MALLET, of the Geological Survey of India, and of PROF. R. T. MALLET, of England.

MR. COX, President of the Council of the Scientific Alliance of New York, reported the publication of a Bulletin announcing the October Meetings of the six Societies within the Alliance. He spoke of the awakened public spirit in New York City as shown in recent splendid private gifts, and hoped the day was coming when the Scientific societies would have a home of their own.

PROF. MARTIN reported that the Audubon Monument Committee had secured nearly the entire amount required.

The Recording Secretary reported the forwardness of the TRANSACTIONS and the publication of the Blue Book of the Academy.

MR. KUNZ stated that the Tariff does not recognize objects of ethnology nor archæology, and a great tax was imposed on importers.

PROF. MARTIN proposed that a Committee be appointed to formulate a resolution calling upon the Secretary of the Treasury to remedy this evil. Carried.

Meeting adjourned.

October 12th, 1891.

STATED MEETING.

PROF. D. S. MARTIN in the Chair. About twenty persons present.

The minutes of the previous meeting (October 5th) were read and approved.

The Secretary announced the nomination of MR. CHARLES PROTEUS STEINMETZ as a Resident Member by DR. FISKE.

PROF. MARTIN presented a communication asking for contributions to a proposed fund for the purpose of establishing the Leidy Memorial Museum, as an independent part of the great museum now forming at the University of Pennsylvania; the amount desired being $50,000.

The Secretary read a letter from the Vice-President of the Royal Academy of Sciences of Lisbon, announcing the death of the Secretary, JOSÉ MARIA LATINO COELHO.

The Secretary exhibited a number of plates accompanying a paper from the Société de l'Industrie Minérale, and entitled "Etudes sur le terrain houille de Commentry." The plates are in elephant folio, and of great beauty.

The Chairman regretted the fact that the Academy Library is so little used by the members.

PROF. N. L. BRITTON then read a paper entitled:—

The American Species of the Genus Anemone, Illustrated by Specimens.

[This paper will appear in the ANNALS, Vol. VI.]

MR. ARTHUR HOLLICK then read the following:—

A Memorial of the late Dr. John I. Northrop.

BY ARTHUR HOLLICK.

It is my privilege to-night to say a few words in regard to the late Dr. John I. Northrop, whom most of us know by reputation, many knew personally, a few, perhaps, intimately. Similarity in the work and occupations of our lives threw us much together during the past two years, and I thus learned to understand and to appreciate him more and more. For this reason, when called upon to do so, I accepted the responsibility of preparing the tribute to his memory, which I propose to present to-night.

John Isaiah Northrop, E.M., Ph.D., was born in New York City, October 12, 1861. He would, therefore, have been, had he lived, just thirty years of age to-day. With the fact of his death we are all acquainted, but in regard to the tragedy in which he lost his life some are perhaps not informed.

On the afternoon of the 25th of last June Dr. Northrop had occasion to obtain some alcohol for use in the preservation of zoölogical specimens. As a measure of safety the main supply at Columbia College is stored in a fire-proof vault under the School of Mines building, from which is drawn, from time to time, such quantities as may be needed. Two janitors accompanied him and together they proceeded to draw off some of the alcohol from the large cask into a smaller vessel. A gas jet and electric light were burning in the hallway, but the vault was dark and Dr. Northrop struck a match in order the better to see how the vessel was filling. Just what happened we shall never know, but the alcohol ignited—there was a momentary playing of flame around the faucet, a flash, an explosion and a sea of fire in the vault. All three of the men were thrown down and badly burned, but Dr. Northrop evidently had his clothing saturated with the alcohol and his injuries were such that he died during the following night.

Dr. Northrop was graduated from the Columbia College School of Mines, in the class of 1884, with the degree of Engineer of Mines. The degree of Doctor of Philosophy was received in 1888, and was earned by his two dissertations: "Histology of *Hoya carnosa*" and "Fossil Leaves from Bridgeton, N. J."

Immediately after graduation he accepted the position of night superintendent at Havemeyer & Elder's sugar refinery, but shortly afterwards removed to Deadwood, Dak., where he joined one of his classmates, and together they opened an office as "Mining Engineers, Chemists and Assayers." In the spring of 1886 he returned to New York, on account of urgent family reasons and decided not to return, but to devote his time to pure science. He was appointed Honorary Fellow, afterwards Fellow in Geology at Columbia College, and rapidly made himself familiar with the principles of botany, geology and zoölogy. Of the latter he made a specialty, and the lectures in this subject at the college during that time were delivered by him. The zoölogical collection in the School of Mines, particularly the invertebrate part, is largely his creation. He also purchased and presented to the college a collection of New England birds consisting of some 1500 specimens, besides miscellaneous material too numerous to mention.

His work in his chosen field of study was evidently appreciated, for on the 5th of last May he was made tutor in Zoölogy, and his appointment was practically settled as the future assistant to Prof. Osborn in the new School of Biology. In order to perfect himself in the duties which he expected soon to assume he had obtained leave of absence for a year, intending to start, during the early part of last September, for Germany, to study under Hertwig and Haeckel.

His loss to Columbia College is already manifest—his loss to science we can only imagine, but the finished and unfinished work which he has left behind him give evidence of acute powers of observation, painstaking study, and a strict regard for truth in recording of facts—all of which qualities are the essentials of a successful man of science. He held membership in the Torrey Botanical Club, American Institute of Mining Engineers, Linnæan Society, American Ornithologist's Union, American Folk-lore Society, American Association for the Advancement of Science, and International Geological Congress, as well as in this Academy.

The titles of his principal published papers are:

Plant Notes from Termiscouata Co., Canada. (Bull. T. B. C., Nov. 1887.)

The Eruption of Krakatoa in 1883. (S. of M. Quart., Jan. 1889.)

Plant Notes from Tadousac and Termiscouata Cos., Canada. (Bull. T. B. C., Feb. 1890.)

Notes on the Geology of the Bahamas. (Trans. N. Y. Acad. Sci., Oct. 1890.)

Birds of Andros Island, Bahamas. (Auk, Jan. 1891.)

The Cultivation of Sisal in the Bahamas. (Pop. Sci. Month., March, 1891.)

In addition to these there are various minor notes and memoranda published mainly in the Bulletin of the Torrey Botanical Club and the American Naturalist.

Among his unfinished works, almost ready for publication, were:—

A List of Star Fishes and Ophiurans collected in the Bahamas, —A List of Sea Anemones collected in the Bahamas with descriptions of two probable new species (illustrated), and The Anatomy of *Hoya carnosa* (illustrated). He was also at work on A Description of the Fossil Plants of the Yellow Gravel of New Jersey, for publication by the U. S. Geological Survey, for which all the illustrations had been made. The general subject of the Yellow Gravel was one in which he was particularly interested, and in regard to which he had collected many notes. He also had in contemplation a work upon the islands of New Providence and Andros, embodying all the lists of collections and the various notes made there by him during the early part of the year 1890. The amount and variety of material collected during this trip (from Jan. 2d to July 10th) was remarkable, and it has always excited my admiration and wonder. Mineralogy, geology, botany, and zoölogy are all represented, and the specimens are carefully labelled or tagged for reference or for future study. One of the birds collected proved to be new to science, and was described and figured by Prof. J. A. Allen in the Auk, vol. viii, Jan. 1891, under the name of *Icterus Northropi.* The two new sea anemones, previously mentioned, and several undescribed plants are also to be included amongst the specimens collected during this trip, and finally it may not, perhaps, be amiss to call attention to the word "rhizomorph," coined by Dr. Northrop as descriptive of the peculiar cylindrical concretions formed around the roots of plants. The word is a singularly happy one, and bids fair to become a permanent addition to scientific terminology.

Dr. Northrop was married June 28, 1889, to Alice Bell Rich, a companion, the value of whose assistance in all his works he never failed to recognize and proclaim—one whom I trust will carry to completion much of the work which he left unfinished behind him.

Dr. Northrop's excessive modesty gave him an appearance of reticence and reserve which was not always understood by those who did not know him intimately. He seemed to appreciate this, and used to think that he never made a good impression on any one, because he felt that he was not a good talker. To those who knew him best, however, this apparent reserve was merely one of the evidences of his retiring disposition, which showed itself in the indifference with which he regarded the discovery and descriptions of new species as compared with the study of their structure and life history. He was an enthusiastic and indomitable collector and careful observer, sparing neither time nor trouble to complete or render correct whatever he undertook. He actually seriously proposed to return to the Bahamas again for the sole purpose of making certain in regard to the exact color of the disc of one of the new sea anemones, that he proposed to have lithographed. Unlike some collectors, however, he could never quite smother his sense of humanity by his enthusiasm as a naturalist, as an instance which came to my knowledge will show. While at Grand Manan, during the summer of 1889, he visited one of the little islands which the petrels had long used as a breeding place. He took several of the young birds out of their holes in the ground, examined them carefully, and, to the surprise of his companion, returned them, not taking even one for a specimen, although they are comparatively rare, and he was not likely perhaps to have such an opportunity again. He said that he could not make up his mind to take one when he appreciated that each mother-bird had but one little one all summer. He afterwards used to laugh at what he called his "foolishness," but I have no doubt that he would have acted in the same manner again under similar circumstances.

One of his former classmates upon hearing that I proposed to say a few words in regard to him, suggested that mention should be made of how he once saved a companion's life at the risk of his own. They were ascending a shaft at one of the Lake Superior mines on a man engine, when his companion, some distance above, missed step and was falling down the shaft. Young Northrop grabbed him as he fell, and succeeded in holding him with one hand while he supported himself with the other. To me this incident is indicative of Dr. Northrop as I knew him. It was an act which called for a strong arm, quick action, and steady nerve, and showed that complete forgetfulness of self which was ever one of his most prominent characteristics.

Meeting adjourned.

October 19th, 1891.

STATED MEETING.

DR. N. L. BRITTON in the chair. About twelve persons present.

The minutes of the preceding meeting (October 12th) were read and approved.

The Secretary read a communication from Vice-President DR. HUBBARD, announcing the appointment of MESSRS. KUNZ, COX, and TATLOCK as a committee to memorialize Congress with regard to the recognition of Archæology and Ethnology in the tariff.

The Secretary announced that the Lecture Course for 1891–92 had been arranged, and that the tickets would be ready for distribution in a few days.

The Chairman announced that the "Bulletin of the Scientific Alliance" had replaced the usual weekly notices.

Dr. Britton exhibited some Spanish chestnuts in the burr, from a grove in southern New Jersey, and now for sale in the lower part of New York City.

Prof. Martin spoke of the existence of a fine rocking stone or perched boulder, about ten feet in every dimension, at West Farms, Westchester County, N. Y.; also of a glacial furrow in Pelham Park.

Prof. J. F. Kemp then read the following paper, entitled:—

The Trap Dikes in the Lake Champlain Valley and the neighboring Adirondacks, Illustrated by Numerous Specimens and Photographs.

BY J. F. KEMP, COLUMBIA COLLEGE, AND V. F. MARSTERS, UNIVERSITY OF INDIANA.

(In the preparation of the complete paper of which this article is a condensation, the writers received a little financial assistance from the United States Geological Survey, through Prof. R. Pumpelly, and the thin sections, to the number of 200, were prepared in the laboratory of the Survey. This digest is published with Prof. Pumpelly's approval. The field-work was done in 1889 and 1890.)

The shores of Lake Champlain consist in greater part of Cambrian and Lower Silurian rocks. The extreme southern end is indeed bounded by the Archæan; and further north, between Port Henry and Split Rock, and between Willsborough and Port Kent, the foot-hills of the Adirondacks reach and form the water-front, but elsewhere it is chiefly made up of the sandstones, limestones, and shales or slates of the early sedimentary systems. The geological relations of the latter have been lately elaborated by Messrs. Walcott, Brainerd, and Seely, but the true succession of the norites, gneisses, and crystalline limestones of the Adirondacks, and even reliable descriptions of their petrographical characters remain to be worked out. The matter hitherto published is but fragmentary, or is based on field observations decidedly incommensurate with the problems involved.

The whole region is seamed with dikes of igneous rock. These pierce both the crystalline rocks of the Archæan and the sedimentary strata up to and including their youngest member, the Utica slate. On the Vermont side, the most southern dike at all connected with the region is the one lately mentioned by Prof. Pumpelly,[1] in the Hoosac Mountain, near the Vermont State line, but the most south-

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[1] R. Pumpelly. The Relation of Secular Rock-Disintegration, etc. Proc. Geol. Soc. of America, vol. ii, p. 209.

erly one described in this paper is in Mt. Eolus, in the town of Dorset, Vt.[1] F. L. Nason has mentioned others from Mt. Holly.[2] We have previously described several from the vicinity of Whitehall and Rutland.[3] North of this point many dikes are recorded in the Vermont Reports and in the earlier work of Zadock Thompson,[4] nearly all of which have been revisited and studied in their sections. On the New York side, the most southerly recorded dike is near Glen's Falls,[5] and several others have been discovered by F. L. Nason near the town of North River, specimens of which have been very kindly placed in our hands. Further north in the region of the magnetite mines, hardly an excavation has been made which does not reveal them. They occur at Hammondville, Mineville, Palmer Hill, at the Arnold mines, and at Lyon Mountain. Many of these are mentioned in volume xv of the Tenth Census, in B. T. Putnam's report on the iron ores. Many other dikes are revealed by the cuts of the D. & H. R. R., especially near Port Kent. The great (supposed) dike at Avalanche Lake, in the Adirondacks, was early recorded,[6] but is shown by our sections to be a shear zone, which will be elsewhere described.

From this brief outline it will be seen that eruptive action has been widespread in the area treated. Similar phenomena are likewise known across the national boundary as far as Montreal, where they are the most extensively developed of any district in the entire region.

The dikes are of two greatly contrasted kinds of rock. The one, quite acidic and essentially feldspathic, is related to the porphyries, trachytes, and keratophyrs; the other, much more basic, includes diabases, camptonites, and monchiquites. The former corresponds to the dike rock bostonite, lately proposed by Rosenbusch as a name for the trachytic dikes, which are well nigh universally associated with elaeolite syenite, and this name will be here employed. We feel conservative about the introduction of new names into our already overburdened science, the more so, as in this case the rocks do not essentially differ from effusive trachytes, but as they occur in dikes and far from any extended central outbreak, and as the institution of the dike rocks affords so much convenience in correlation, the special term is adopted.

The Bostonite (*Porphyry, Trachyte*) *Dikes.*—The name boston-

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[1] Geology of Vermont, vol. ii, p. 586.

[2] F. L. Nason. A New Locality for the Camptonite of Hawes and Rosenbusch. A. J. S. iii, xxxviii, 229.

[3] J. F. Kemp and V. F. Marsters. Camptonite Dikes near Whitehall, N. Y. Amer. Geol., iv, 97.

[4] Zadock Thompson. Appendix to Thompson's History of Vermont, Burlington, 1853, p. 53.

[5] E. Emmons. Geol. of 2d Dist. N. Y. State Survey, p. 184.

[6] W. C. Redfield. Some Account of two Visits to the Mountains of Essex County, N. Y., 1836–37, etc., Amer. Jour. Sci., i, xxxiii, 301. See also First Ann. Rep. N. Y. State Survey, 1837, p. 131; 2d do., 1838, p. 223; and Emmons' final Report, p. 215.

ite was coined by Rosenbusch,[1] and was first applied to a dike rock of trachytic habit that occurs with the elaeolite-syenite of Brazil. The name is based on the descriptions of rocks of this character from near Boston, under the names porphyry and trachyte by Wadsworth, Diller, and others. These rocks from the Champlain Valley have a prevailingly light tint, which is usually a creamy or brownish white, but which is also in instances a light chocolate. They have a general rough and granular feel and fracture very like typical trachyte. Very rarely this is lithoidal or half vitreous, like a lithoidal obsidian. Phenocrysts are not in general specially marked, the less so, because widespread alteration makes fresh material difficult to obtain. When present they exhibit the shining cleavage faces of feldspar. One dike from the east side of Shelburne Point, near Burlington, consists almost entirely of the large porphyritic feldspars. Quartz is much rarer, although recognized as a phenocryst in two dikes.

Under the microscope these rocks are seen at once to have a marked and characteristic trachytic structure, by which is meant that the ground mass consists of small feldspar rods, not infrequently in fluidal arrangement. Between the rods one can sometimes detect small masses of interstitial quartz. The ground mass is invariably holocrystalline and the feldspars are idiomorphic. The quartz is not. The phenocrysts average 3–5 mm. Although generally kaolinized, it can be seen that they are but once twinned, and are in the great majority of cases orthoclase. The small crystals are also once twinned, but as shown by the analyses they are probably both orthoclase and anorthoclase. A very few plagioclases have been noted. When alteration has made the feldspars of the ground mass muddy or kaolinized they look like so many sections of grains of wheat lying together.

It is a remarkable fact that in no case have any recognizable dark silicates been found in a slide. Spots of limonite and iron stains are indeed seen in some, and these may have once been bisilicates, but it is doubtful, for none appear in the freshest material. Nor is any magnetite noted. A few stray crystals and masses of pyrite alone appear. The dikes are singularly free from any basic minerals and present a very pure, crystallized, feldspathic magma.

In alteration the dikes afford nests of calcite and quartz, and the usual muddy kaolin is abundantly present. The calcium for the formation of calcite was doubtless derived in large part from the neighboring slates, in which this mineral is very common.

The following analyses illustrate the range of compositions. No. 66 is probably nearest the average. While it appears very fresh

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[1] M. Hunter and H. Rosenbusch. Ueber Monchiquit, ein Camptonitisches Gang-gestein aus der Gefolgschaft der Elaeolith-syenite. Tschermak's Min. u. Petr. Mitth. xi, p. 445, 1890. The bostonite is incidentally mentioned evidently as a "caveat," but applies so well that we are glad to adopt it. After our determinations had been made, Professor Rosenbusch kindly looked over some specimens sent him and pronounced the rocks to be typical bostonite.

in the slide, it is shown by the loss to have suffered some alteration. No. 102, taken from the Vermont report, p. 585, is the cementing magma of a breccia dike to be later described. No. 11 is abnormal and is of the coarsely crystalline dike of Shelburne Point, referred to above.

	No. 66, Kemp, $\frac{2}{2}$.	No. 11, Morrison, $\frac{2}{2}$.	No. 102, G. F. Barker.
Loss	2.33	6.57	1.70
SiO_2	62.28	53.40	67.30
Al_2O_3	19.17	20.82	19.10
Fe_2O_3	3.39	3.92	
CaO	1.44	7.05	0.79
MgO	trace	1.53	trace
K_2O	5.926	2.97	4.74
Na_2O	5.374	3.79	6.04
	99.91	100.05	99.67
Sp. gr.	2.648.		

No. 11 was kindly analyzed by Mr. W. M. Morrison, resident graduate in chemistry at Cornell University. The amount of soda in No. 66 is very suggestive. As no well-marked plagioclase appears in the slide, which is of a very homogeneous rock, the inference is strong that some soda orthoclase (anorthoclase) is present and that the dike is really allied to the keratophyrs and pantellerites. Years ago (1853–56) T. Sterry Hunt separated a number of feldspar crystals from related dikes in the region of Montreal, and, as shown by the accompanying analyses (I–IV inclusive), they furnish close parallels. V and VI are analyses by Förstner of the anorthoclase of the trachytic rocks of the island of Pantellera, and their similarity with the older analyses of Hunt is very striking. Analysis VII, by T. M. Chatard, of the keratophyr described by J. H. Sears, from Marblehead Neck, is wonderfully like the others. The keratophyr described by W. S. Bayley, from Pigeon Pt., Minn., is much higher in silica (A. J. S., iii, xxxvii, 54).

	I.	II.	III.	IV.	V.	VI.	VII.
SiO_2	65.70	65.15	66.15	67.60	66.06	66.03	65.66
Al_2O_3	20.80	20.55	19.75	18.30	19.24	19.37	20.05
FeO	—	—	—	—	0.54	—	trace
Fe_2O_3	—	—	—	1.40	—	1.53	trace
MnO	—	—	—	—	—	—	0.13
CaO	0.84	0.72	0.95	0.45	1.11	0.73	0.67
MgO	—	—	—	—	0.11	0.02	0.18
K_2O	6.43	6.32	7.53	5.10	5.45	5.40	6.98
Na_2O	6.52	6.67	5.19	5.85	7.63	7.57	6.56
Loss	0.50	0.50	0.55	0.25	none	none	0.41
	100.79	99.99	100.12	98.95	100.14	100.65	100.64

I. T. S. Hunt, Feldspar from Brome (Canada), Trachyte, A. J. S., ii, xxxviii, 97; Geol. Canada, 1853–56.

II. " Feldspar from Shefford, Canada, l. c., p. 97. F. D. Adams has described a rock from Shefford as quartz-free porphyry, Geol. Canada, 1880, '81, '82, p. 10A.

III. T. S. Hunt, Feldspar from Chambly, l. c., p. 98.
IV. " Feldspar from ground-mass of Chambly dike after treatment with dilute nitric acid, l. c., p. 98.
V. and VI. H. Förstner, Zeitschr. f. Xtal., viii, 125, 202, 1883; Neues Jahrb., 1884, ii, 171.
VII. J. H. Sears, On Keratophyre from Marblehead Neck, Bull. Mus. Comp. Zoöl., xvi, No. 9, p. 170.

In the further discussion of the basic dikes it will appear that in the close association which they show in the field with bostonite we have a mingling of rock types not unlike that long known at Montreal,[1] in many respects similar to that at Marblehead, near Boston,[2] and to the dikes recently brought to notice near Rio Janeiro, Brazil.[3] In all three localities they are associated with elaeolite-syenite. This latter rock has not yet been discovered nearer to Lake Champlain than Montreal, which is one hundred miles north of Burlington. It is not improbable that elaeolite-syenite may yet appear in the eastern Adirondacks.

The Breccia Bostonites.

On the east side of Shelburne Point, which is just south of Burlington, and also on the west side, a broad dike (20 feet) outcrops. It is undoubtedly continuous between. It is a most remarkable rock, and consists of angular pieces of slate and red quartzite cemented together by an igneous base. The cementing base is not very fresh in the attainable specimens, but is clearly of the same nature as the ground-mass of the bostonites. The included fragments are angular and seldom show any absorption into the igneous rock. Two explanations may be advanced for this dike. One, that it has been intruded on a line of previous faulting and attrition, which have broken up the walls and have left loose material to be gathered up by the rising magma. This explanation has the greater

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[1] T. S. Hunt, papers cited under analyses I–IV above; also, Geol. of Canada, 1863, p. 655. B. J. Harrington, idem, 1877–78, p. 429. A. Lacroix, Sur la Syènite-elaeolithique de Montreal, etc., Comptes Rendus, June 2, 1890, p. 1152, and Descriptions des Syénites néphéliniques de Pouzac, Hautes-Pyrénées et de Montréal, etc., Bull. Soc. Geol. France, 3, xiii, 1890, 511–558.

[2] A. Hyatt, Remarks on the Porphyries of Marblehead, Mass., Proc. Boston Soc. Nat. Hist., xviii, p. 220, 1876. T. T. Bouvé, The Origin of Porphyry, idem, xviii, p. 217. M. E. Wadsworth, The Trachyte of Marblehead Neck, idem, xxi, p. 288; Geology of Marblehead, idem, xxi, p. 306; Zircon Syenite from Marblehead, idem, xxi, p. 406. W. O. Crosby, Geology of Eastern Massachusetts. J. S. Diller, The Felsites and their Associated Rocks North of Boston, Bull. Mus. Comp. Zoöl., vii, 165. J. H. Sears, Keratophyr from Marblehead Neck, idem, xvi, 167.

[3] O. A. Derby, On Nepheline Rocks in Brazil, etc., Quart. Journ. Geol. Soc., London, 1887, p. 457. F. Fr. Graeff, Mineralogisch. Petrograph. Untersuchung von Elaeolith-syeniten von der Serra de Tingua, etc., Neues Jahrbuch, 1888, ii, p. 222. Hunter and Rosenbusch, Ueber Monchiquit ein Camptonitisches Ganggestein aus der Gefolgschaft der Elaeolith-Syenit. Tsch., Min. u. Petrog. Mitt., xi, 1890, p. 44.

weight with the writers. The other is that it represents only the upper portion of a dike, and thus contains the float-material which the advance of an igneous body would naturally gather from the walls. The lack of such inclusions in the neighboring dikes may be due to the fact that their tops have been eroded. A still different view has been advanced by Pres. Hitchcock as applicable to a second similar dike, to which we now pass.

This second dike is much narrower, and is found on Nash's Point, some miles south. It is about twelve feet wide, and consists of somewhat rounded fragments of Archæan norite, red Cambrian quartzite, and Hudson River slate, chiefly gathered in the middle portion, and all cemented together by the bostonite ground-mass, whose analysis was given above. President Hitchcock[1] mentions, also, gneiss, hornblende-schist with garnets, quartz, gray sandstone, and black Trenton limestone. Probably what he called granite we have called norite. The slides of norite and quartzite exhibit dynamical effects of a marked character, as the crystals have been strained and shattered. These inclusions indicate a deep-seated source for the igneous rock—at least beneath the norites and gneisses, and one or two inclusions in a basic dike from Burlington indicate the same for the basic dikes. President Hitchcock was impressed by the rounded, or, as he interpreted it, the waterworn character of the inclusions. He was led by this to regard the dike as originating from a crack which had become previously filled with débris from above. This débris he considers to have been partially melted or sintered in the metamorphism of the region. As some of the boulders are limestone, and as there are many undoubtedly intrusive igneous dikes within a few feet, we regard the rounded character as due to partial absorption, and consider the foreign bodies as inclusions. Brecciated porphyries formed of a broken eruptive rock that has been re-cemented have been mentioned by Pumpelly from Pilot Knob[2] and by Crosby[3] from eastern Massachusetts, but the phenomena are obviously different from those here described.

The Basic Dikes.

The basic dikes are all compact, dark rocks, that to ordinary microscopic examination, give almost no indication of their constitution. The only apparent minerals are feldspars in the coarser diabases, and an occasional glistening hornblende or augite prism in the more basic dikes. The thin sections exhibit a series of mineralogical mixtures extending from very typical ophitic diabase through camptonites, in which the dark silicates become idiomorphic, and the feldspars recede, to aggregates of augite and hornblende,

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[1] E. Hitchcock, On Certain Conglomerated and Brecciated Trachytic Dikes in Vermont, etc., Proc. A. A. A. S., xiv, 156; Geol. of Vermont, vol. ii, p. 583.

[2] R. Pumpelly, Geological Survey of Missouri, Preliminary Report on the Iron Ores and Coal Fields. E. Haworth, Missouri Geological Survey, 1891, Bull. v.

[3] W. O. Crosby, Geology of Eastern Massachusetts, p. 50.

lacking feldspar entirely, and having comparatively little glass. Olivine is occasionally seen in a fresh condition, but in most dikes an alteration product not always satisfactory alone indicates its probable original presence. The basic dikes are described under the following three types, diabase including olivine-diabase, camptonite, and monchiquite.

The Diabase.

The true diabase dikes are principally, if not quite entirely found in the crystalline Archæan areas. They are thus on the west side of the lake, and in several cases back in the mountains. Diabase is the characteristic type of rock that forms the dikes which so plentifully intersect the lenses of magnetite.

The rocks exhibit, under the microscope, the characteristic ophitic structure with occasional radiating arrangement of feldspars (divergent-strahlig of Lossen). These have, at times, a dark core which follows the outline of the crystal, and is, doubtless, an altered portion stained by infiltration. The plagioclase was separated from a coarse dike from near Port Kent, and afforded the following analysis:—

	I.	II.	At. Ratio.	
Loss	0.72			
SiO_2	57.82	58.38	.973	11
Al_2O_3	28.16	28.43	.276	3
CaO	7.72	7.79	.139	$\frac{3}{2}$
Na_2O	5.35	5.40	.087	1
	99.77	100.00		

From this it appears that the feldspar belongs in the andesite series. Column II is recalculated to throw out the loss on ignition.

The augite tends to become at times idiomorphic, and marks a passage into the augite-camptonites. This tendency is wide-spread, and indicates the close affinities of the two rocks. The augite varies from pink to greenish. In the heavy residues obtained by panning crushed material, some grains of hypersthene were found, although none were ever noted in the slides. The discovery is interesting in connection with its recently found presence in Triassic diabase.[1] Subordinate biotite is occasionally seen in scales with magnetite, and is regarded as an original mineral.[2] Irregular grains of magnetite are abundant.

The process of alteration seems to be the same wherever noted. The bisilicates pass into chlorite, or into what in other cases appears to be serpentine. The latter is a yellow or amber colored mass, not always showing a very marked, aggregate character. It is lacking in pleochroism and is not very strongly refractive. Some dikes are in such an advanced stage of alteration that they present

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[1] Campbell and Brown, Composition of certain Mesozoic Igneous Rocks from Virginia, Bull. Geol. Soc. of America, 1891, p. 339.

[2] Wadsworth takes a different view of similar biotite, regarding it as secondary, Bull. ii, Min. Geol. Surv. p. 65, and Pl. iii.

almost nothing of a diagnostic character. Clay or kaolin, calcite, limonite, and indefinite dirt make up the slide. Very little recognizable epidote has been noted.

An interesting and exceptional alteration is afforded by the dike at Palmer Hill, near Ausable Forks. The feldspar has yielded a colorless, negative, uniaxial, rather brightly polarizing mineral with abundant rectangular cleavages. This is scapolite. It often forms secondary nests with quartz. Scapolite as an alteration product from plagioclase has long been known in connection with various rocks which are associated with the apatite deposits of Norway, and has more recently been discovered in the same relations in Canada.[1] The process has been discussed by Judd.[2] It is urged that solutions of sodium chloride penetrate the plagioclase along "solution planes,"[3] after which dynamic metamorphism in connection with the sodium chloride changes the plagioclase to scapolite. In the present instance there seems to have been no dynamic metamorphism, but it is likely that infiltrating sodium chloride or of hydrochloric acid may have aided the change. Lacroix has also recently described the alteration of plagioclase to dipyr, in a diabase of the Pyrenees.[4]

The Palmer Hill dike yielded, on analysis, the results in column I. By its side is placed for comparison No. II, which is the analysis of a diabase from near Boston, and No. III is one from the Keene Valley.

	I. Kemp.	II. Hobbs.[5]	III. Leeds.[6]
SiO_2	45.46	48.75	43.41
Al_2O_3	19.94	17.17	19.42
Fe_2O_3	15.36	0.41	5.72
FeO	—	13.62	6.69
CaO	8.32	8.82	9.11
MgO	2.95	3.37	5.98
MnO	—	0.91	—
K_2O	3.21	2.40	0.47
Na_2O	2.12	1.63	4.39
TiO_2	—	0.99	0.35
P_2O_5	—	0.68	—
CO_2	—	trace	2.00
FeS_2	—	trace	—
Loss	2.30	—	3.00
	99.66	100.17	100.54
Sp. gr.	2.945	2.985	

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[1] F. D. Adams and A. C. Lawson, On some Canadian Rocks containing Scapolite, etc., Canadian Record of Science, 1888, p. 185. The paper gives copious references to the literature and a valuable review of the same.

[2] J. W. Judd, on the Processes by which a Plagioclase Feldspar is converted into Scapolite, Mineralogical Magazine, vol. viii, p. 186.

[3] For the description of solution planes, see J. W. Judd, Q. J. G. S. xli, 383, 1885; xlii, p. 82, 1886; Mineralog. Mag. vii, p. 81, 1886.

[4] A. Lacroix, Sur les Phénomènes de Contact de la Syenite elaeolithique de Pouzac, Comptes Rendus, No. 110, p. 1011, 1890.

[5] W. H. Hobbs, On the Petrographical Characters of a Dike of Diabase in the Boston Basin, Bull. Mus. Comp. Zoöl., xvi, 1.

[6] A. R. Leeds, Notes on the Lithology of the Adirondacks, 30th Ann. Rep. N. Y. State Museum, p. 102.

In I all the iron was estimated as Fe_2O_3. The excess of potash over soda in I and II is exceptional. While the rather abundant biotite of I in part accounts for it, the amount of this mineral is hardly enough to furnish it all. The silica is also lower than in the Triassic diabases, which afford about 50–53 per cent.

Olivine appears in a few dikes fresh enough to recognize, and an alteration-product is shown by a great many more which may have resulted from it. In other respects the olivine diabases are not different from those without this mineral.

Diabase, including olivine diabase, is an extremely common dike rock in the Archæan rocks of Canada and the northern United States, and it is probable that most of those simply recorded as trap belong also with this species.

The Camptonites.

The name camptonite was originally employed by Rosenbusch to designate those dike rocks which consist of hornblende and plagioclase, but varying amounts of augite are also often present. They lack the ophitic structure of diabase in that the hornblende or augite is prevailingly idiomorphic. The diabases of dikes thus pass into them by the idiomorphic development of the dark silicates. In the Lake Champlain region there are dikes of both the augitic and the hornblendic variety. We have employed the name augite-camptonite when wishing to make a distinction.

The camptonites consist of brown basaltic hornblende, augite, plagioclase, magnetite, and occasionally a little intermingled glassy matter. The minerals are markedly panidiomorphic and the large hornblendes and augites give at times a porphyritic character. The hornblende is the most conspicuous and attractive component. It is strongly pleochroic, brown to yellow, and, in distinction from the augite, shows no zonal structure. A small second generation consists of minute acicular crystals, which are a miniature reproduction of the larger forms. The augite likewise forms two generations. The older and larger consists of zonal prismatic crystals with dark green cores and light yellow rims, which may differ 10° in extinction. The second generation are minute and acicular. The plagioclase is less perfectly developed than the bisilicates. Several camptonites contain abundant olivine.

The camptonites all contain less than 45 per cent. SiO_2 in this region, but in other respects present great variability. They do not afford more than 6 per cent. of alkalies, with soda usually in excess. The following table illustrates the range of composition :—

	I.	II.	III.	IV.	V.	VI.
SiO_2	43.50	41.00	41.94	40.95	48.19	44.87
Al_2O_3	17.02	21.36	15.36	16.45	16.79	17.28
Fe_2O_3	13.68	13.44	3.27	13.47	18.37	11.04
FeO	—	—	9.89	—	—	—
MnO	—	—	0.25	0.33	—	trace.
TiO_2	—	—	4.15	3.39	—	6.74
CaO	8.15	10.40	9.47	10.53	6.85	7.54
MgO	6.84	3.85	5.01	6.10	1.32	4.95
K_2O	3.02	1.31	0.19	1.28	1.11	2.62
Na_2O	2.84	2.86	5.15	4.00	5.59	1.61
P_2O_5	—	—	—	0.29	—	0.45
CO_2	—	—	2.47	—	—	—
Loss	4.35	5.00	3.29	3.84	2.31	2.49
Total	99.40	99.22	100.44	100.63	100.53	99.59

I. Fairhaven, Vt. By J. F. Kemp, Amer. Geologist, Aug. 1889, p. 97.
II. Proctor, Vt. do. do. do.
III. Campton Falls, N. H. G. W. Hawes, Amer. Journ. Sci., iii, xvii, 14.
IV. Montreal. B. J. Harrington, Geol. Survey of Canada, 1877–78, p. 439.
V. Forest of Dean, Orange Co., N. Y. J. F. Kemp, Amer. Journ. Sci., April, 1888, p. 331.
VI. Fort Montgomery, Orange Co., N. Y. By L. M. Dennis for J. F. Kemp, Amer. Naturalist, Aug. 1888, p. 694.

The Monchiquites.

The name monchiquite has been lately introduced by Rosenbusch[1] to include a group of dike rocks consisting of olivine, augite, hornblende, biotite (one or all three of the last named), and a glassy base. It is derived from the Monchique Mts. in Portugal, where such dikes were discovered in 1850. In the further development of the Lake Champlain dikes toward the extreme basic end of the series there are a number consisting chiefly of zonal augite, small brown hornblende and biotite crystals, and olivine, in an unresolvable base that is only very feebly refractive, if not actually glassy. Yet some slides do show minute plagioclase crystals in the ground mass, but not in sufficient development to throw them into the camptonites. Magnetite is the only additional mineral. The augite is the same as that described under the camptonites, and is in two generations. It makes up at times almost if not quite the entire rock and the analysis (No. 14) given below must indicate the approximate composition of this mineral. Magnetite is the only other component of note. The hornblende is also like that of the camptonites, but when the second generation becomes very small it is very difficult to distinguish it from biotite. In the altered portions of the base they seem much more abundant than in the fresh, as they stand out with very sharp definition. The alteration-product is calcite. The hornblende in one or two instances replaces the augite

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[1] M. Hunter and H. Rosenbusch, Ueber Monchiquit, ein Camptonitisches Ganggestein, etc., Tsch. Min. u. Petrog. Mitth., xi, 1891, p. 445.

entirely and affords a very beautiful slide. The olivine is seldom fresh enough to be certainly identified, but as masses of a green alteration product are almost always present its occurrence is probably wide-spread. Professor Rosenbusch has, with characteristic kindness, looked over some slides of certain of these dikes, and fully indorses the determination of them as monchiquite, which had been previously made by us.

The following analyses illustrate the range in composition:—

	No. 2.	No. 14.	No. 21.
SiO_2	40.37	45.13	44.30
Al_2O_3	17.86	18.06	7.92
Fe_2O_3	14.45	11.88	25.38
FeO	0.38	0.32	not det.
CaO	17.61	10.17	14.67
MgO	1.63	1.12	1.98
K_2O	0.83	6.06	—
Na_2O	1.29	3.57	—
Loss	4.47	3.04	4.35
	99.39	99.35	98.60

No. II also contains P_2O_5, 0.39. No. 2 and No. 14 were kindly analyzed by Mr. W. H. Morrison, graduate student in chemistry at Cornell University, and No. 21 by Mr. E. M. Chamot, assistant in the same laboratory. The rocks are thus very basic and may, as in No. 21, be very low in alkalies.

The above-mentioned basic dikes and the bostonites are very commonly associated with elaeolite-syenite, and we think they furnish good reasons for anticipating the discovery of this rock in the region of the Adirondacks. The dikes may, however, be an extreme southern development of the great eruptive activity near Montreal. We think their intrusion accompanied the upheaval of the Green Mountains.

During the field-work of the second summer Mr. A. S. Eakle, now of the geological department of Cornell University, accompanied the writers, and acknowledgments are due him for much valuable assistance.

PROF. MARTIN asked the lecturer if the smaller dikes might not perhaps be regarded as originating from the larger ones. PROF. KEMP replied that they could hardly be so regarded, and added that the nearest large masses of eruptive rock were in the vicinity of Montreal.

Meeting adjourned.

October 26, 1891.

STATED MEETING.

DR. A. A. JULIEN in the chair. About forty persons present.

The minutes of the previous meeting (October 19th) were read and approved.

The Eggs of the Plover.

Dr. H. C. Bolton stated, when in England last summer he noticed that the eggs of the common plover or Lapwing (*Charadriinæ*), eaten as a delicacy, have a peculiar appearance when hard-boiled, the white remaining quite transparent and permitting an unobstructed view of the yelk within.

This fact so commonly known to English epicures does not seem to be familiar to all ornithologists. Occasional mention of similar phenomena is found however. Mr. George W. Peck, in a work entitled "Melbourne and the Chincha Islands" (New York, 1854), describes the Guano Islands off the coast of Peru, and speaking of the myriads of birds says: "The Cholos climbed the precipices after eggs like so many monkeys. They obtained a great many, and we had omlets made of them which were excellent; in boiling or frying them the white remains transparent" (page 186). For this reference Dr. A. R. Ledoux should receive thanks.

These facts point to a peculiar condition of the albumen in certain eggs that has long been known to chemists. Fremy and Valenciennes, in 1857, found that there are three conditions of albumen differing in chemical properties, yet identical in composition. The first is coagulated by heat becoming opaque, and is precipitated by nitric acid. The second also coagulates on heating, but remains transparent. The third is not affected by heat nor by nitric acid. The first condition exists, according to these French authors, in the eggs of different species of gallinaceous birds; the second is peculiar to the eggs of swimming and wading birds, and the third is peculiar to the eggs of predaceous birds and of some kinds of perching and climbing birds. (*Ann. chim. phys.* [3] L. 138.)

The subject seems to be worthy of further investigation.

DR. THOMAS MORONG was then introduced, and delivered the opening lecture of the public course entitled "Paraguay, the Land and the People," illustrated by lantern views. At the close of the lecture a vote of thanks was tendered DR. MORONG and the meeting adjourned.

November 2, 1891.

REGULAR BUSINESS MEETING.

PROFESSOR J. K. REES in the chair. Thirteen persons present.

The minutes of the previous Business Meeting (October 5) were read and approved.

MR. CHARLES R. MANN was nominated as a Resident Member by MR. HAROLD JACOBY.

DR. H. T. VULTÉ was elected Librarian by ballot.

The following persons were then elected Corresponding Members by ballot:

JOSÉ G. AGUILERA, of Mexico City,
L. CLERC, of Ekaterinburg Russia,

and the following Resident Members by ballot:

DEWITT J. APGAR,
DR. CLARK BELL,
PROF. ALBERT H. CHESTER,
ERNEST DU VIVIER,
MRS. EDWARD HEYLYN,
ARTHUR HOLLICK,
PROF. JAMES F. KEMP,
GEORGE H. KNIGHT,
ERNEST LEDERLE,
J. PIERPONT MORGAN,
HEINRICH RIES,
WM. C. SCHERMERHORN,
NELSON SMITH,
CHARLES PROTEUS STEINMETZ,
MISS VIRGINIA VAUGHAN.

The Astronomical Section then organized with PROF. REES in the chair; the minutes of the section were read by the Secretary, MR. JACOBY.

The following paper was read:

On the Reduction of Transit Observations by Least Squares.

BY HAROLD JACOBY.

[This paper will appear in one of the monthly notices of the Royal Astronomical Society.]

PROF. REES referred to the publication of the index of plates presented to the Observatory of Columbia College by MR. RUTHERFURD. This led to correspondence with PROF. EDWARD S. HOLDEN of the Lick Observatory, who requested a series of copies of the negatives of the moon. These were made by MR. MONELL, forty in number, and sent to PROF. HOLDEN, who is much pleased with them. MR. HOLDEN intends, eventually, to publish what may be called the "Lick Map of the Moon," embodying results of examinations made of the Lick Photos by observers in Europe and America. PROF. REES referred to the especial value of Rutherfurd's Photographs of the Moon in examining the question as to changes going on in the lunar surface.

Meeting adjourned.

November 9, 1891.

STATED MEETING.

DR. A. A. JULIEN in the chair. About nineteen persons present.

The minutes of the previous meeting (Oct. 26th) were read and approved.

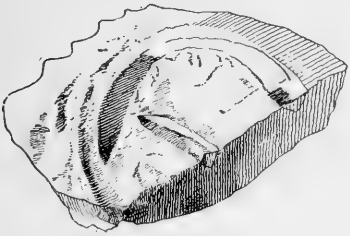
DR. RUSBY exhibited the head of a South American Indian curiously preserved, leaving the hair and features intact, while the whole cranium is reduced to the size of a billiard ball. DR. FRIEDERICH and others made a few remarks in regard to this method of preserving the head as a trophy, a custom common among certain tribes. The reduction is supposed to be effected by alternate boiling and compression; certainly the process is slow and tedious.

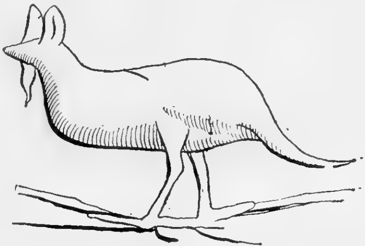
The following paper was then read:

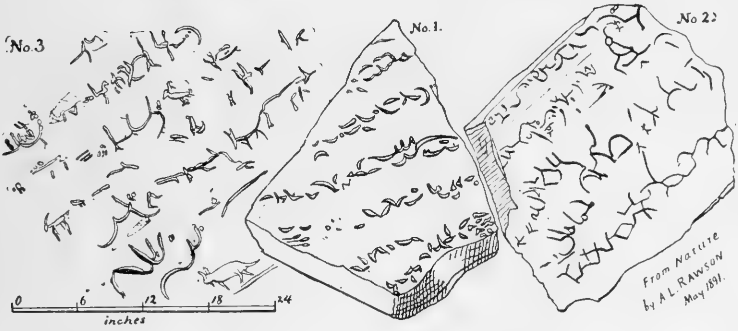
The Ancient Inscription on a Wall at Chatata, Tennessee.

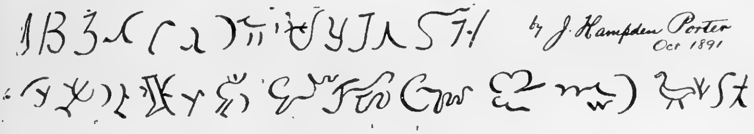
BY A. L. RAWSON.

Mr. J. H. Hooper found what appeared to be a headstone to a grave, on a wooded ridge on his farm, in Bradley County, Tennessee, about thirteen miles from the railroad at Cleveland. He dug around the stone, expecting to find a name, but instead found only curious unknown letters or marks. He dug deeper and uncovered other stones that formed a wall of three courses, in all about two feet thick, eight feet high, and about sixteen feet of its length, as measured from the north end, was covered with the letters, arranged in wavy, nearly parallel and diagonal lines. The wall was traced and examined in many places for a distance of nearly a thousand feet, its course marked on the surface by stones like No. 1, projecting a few inches above the surface of the ground, and twenty-five or thirty feet apart. Seventy-five feet of the south end of the wall was bent at an angle of 15° to 20° east. The wall ended in a hollow of the hill.









In March, 1891, the *Cleveland Express* printed a short account of the discovery, written by Mr. Carson of that place, who had seen the wall. In the *Sunday Sun*, New York, June 7th, I published a short notice of the find, with engravings made from my sketches made at the place, May 21st. The engravings in this article are from my sketches corrected by photographs.

The stone is dark-red sandstone, and the wall lies along the crest of a ridge of that kind of stone which trends north and south, flanked by limestone east and west, and extending from the Hiawassee River north to Chattanooga, south where it dips below the bed of the Tennessee River.

The surface of the west side of the inner course of stones is cut into rounded ridges with hollows between, and the characters are raised on the crest of the ridges, and are from two inches to three inches in width, with a few larger groups.

Mr. J. Hampden Porter says, in a letter from Chatata, October 21st: "It is not a wall but a red sandstone ridge, faced with red, slaty, and yellow clays to an unknown depth. No implements and no traces of previous excavations have been found." The faces of the other course of stones are level and not cut into grooves. Between the courses is found a dark-red cement, which is probably formed of red clay with salts carried down by water.

Mr. Porter says: "As a rule inscriptions are intended to be read. . . . . I do not remember any instance of a designed concealment like this."

The architect of the Pharos at Alexandria, Egypt, cut his name on the stone, covered it with plaster, and moulded Pharaoh's name in the covering. Time tore off the plaster and exposed the builder's name. This concealment in Tennessee may have been effected in a time of invasion or some great social calamity.

Eight hundred and seventy-two characters have been examined, many of them duplicates, and a few imitations of animal forms, the moon and other objects. Accidental imitation of oriental alphabets are numerous.

The rock was chiseled in the form of letter intended, a hard cement worked in and raised above the surface, and a cement placed over the whole, against which the outer course of stones was placed, fitting closely. A piece of this covering cement with the letter-form in its surface is engraved here. The bird or other animal is the largest of that kind of figures that is found on the wall. Some of these forms recall those on the Dighton Rock, and may belong to the same age. How many other hidden inscriptions there may be in this, the geologically oldest continent, it is impossible to say but delightful to conjecture. This wall would be a valuable and interesting addition to the Metropolitan Museum.

Considerable discussion followed the reading of this paper, and was participated in by DRS. JULIEN and BOLTON, and PROF. MARTIN and others.

Prof. D. S. Martin spoke at some length upon the features of peculiar interest connected with the series of scientific meetings held during August, 1891, at Washington, particularly the International Geological Congress. He described in outline the general plans and arrangements for the session and the topics that were discussed on the several days. The exhibition of geological material and literature was referred to and some of its leading features specified; among these, the great display made by the

U. S. Geological Survey of reports, monographs, maps, reliefs, and photographs; the large collection of Mexican rocks exhibited by the delegates from that country; the remarkable Ordovician fish-remains recently collected and described by Prof. Walcott from near Cañon City, which carry back the evidences of fish-life to a horizon corresponding to the Trenton limestone of the Eastern United States; the illustrations of mountain structure and rock-folding produced by Mr. Bailey Willis, by laterally compressing layers of clay and plaster under heavy weight; and, of extreme interest, the photographs and specimens of glacial markings in Silurian rocks, exposed to view by the removal of overlying beds in Scandinavia, and apparently affording clear evidence of an early Paleozoic ice period.

The several days' programs were referred to further; the exhaustive classification by Prof. Chamberlain of quaternary deposits, introductory to the discussion of that subject; the second day's topic of Geological Correlation, and the views of leading specialists, both American and foreign, as to the methods, principles, and possibilities in that great field; and, later, the subject of Geological Cartography, with a description of Major Powell's account of the comprehensive and elaborate scheme of combined colors and patterns adopted for the extensive work of the U. S. Geological Survey. This Prof. Martin illustrated with blackboard drawings and one of the new survey maps.

Meeting adjourned.

November 16, 1891.

STATED MEETING.

MR. P. H. DUDLEY in the chair. About seventy-five persons present.

The minutes of the previous meeting (November 9th) were read and approved.

PROFESSOR HENRY F. OSBORN, of Columbia College, was proposed as a Resident Member by DR. N. L. BRITTON.

PROF. OTIS T. MASON, of Washington, D. C., was then introduced and delivered a lecture entitled

Woman's Part in the Earlier Civilizations,

illustrated by numerous lantern slides.

At the close of the discourse a vote of thanks was extended to the lecturer, and the meeting adjourned.

November 23, 1891.

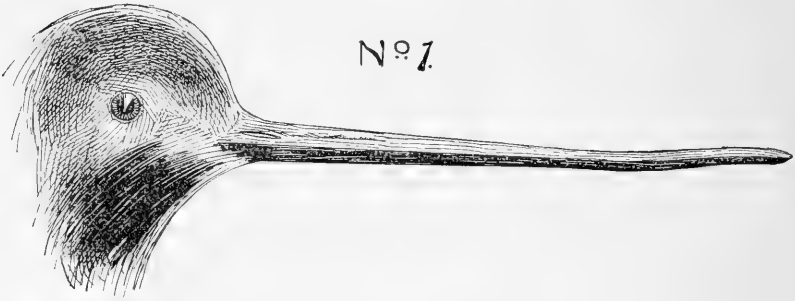
STATED MEETING.

Vice-President ALLEN in the chair. About forty persons present.

The minutes of the previous meeting (November 16th) were read and approved.

Professor Trowbridge presented two sketches relating to animal mechanics, and illustrating a discovery by his son C. C. Trowbridge, connected with the mechanism by which certain birds secure their food by boring in soft ground.

The sketches represent the head and bill of the Hudsonian Godwit. Sketch No. 1—the mandibles closed as in the act of boring; and No. 2, the bill as in the act of seizing its food under ground.



Nº 1.

Nº 2.

Professor Trowbridge stated that it is well known to naturalists and sportsmen that in the boring birds, such as the godwits, snipe, and woodcock, the upper mandible at its extremity is quite flexible, and may easily be bent upwards as shown in sketch No. 2. But that it has not been known, as far as he is aware, that this bending is also under the control of the bird, and is accomplished by certain muscles about the base of the mandibles; the muscles being connected mechanically, in an interesting manner, with the extremity of the upper mandible—along the cavity of this mandible.

The fact that immediately after the death of the bird, when the bill is in its flexible condition, this opening of the bill, at its extremity, may be accomplished by any one who knows how to produce the proper action of the muscles, was discovered by Mr. C. C. Trowbridge about two years ago, while examining specimens of the Hudsonian godwit that he had shot. An examination of the woodcock by him showed similar action.

The solution of the object of the flexibility of the upper mandible at its extremity, connected with the fact that the opening of the bill at the end (as in sketch No. 2) is under the control of the bird, is doubtless as follows:

When the bill is forced into soft ground it must be closed to its very extremity; it then acts like an awl. To open the bill and seize an object reached, if both mandibles were hard and inflexible throughout their whole length it would be necessary for the bird to enlarge the hole around its bill along its whole extent; an operation requiring much force, and possibly the opening and closing would be in such case impracticable. But the opening at the extremity to the slight extent necessary to take in its food is comparatively a simple matter. Moreover, when the food is seized and the bill withdrawn through the small hole made by the bill the effect during the whole of the withdrawal of the bill is to cause the food to be clasped more firmly and securely. The operation of withdrawing the food would otherwise be very difficult, and possibly impracticable.

Professor Trowbridge also presented the results of some further observations made by Mr. C. C. Trowbridge, on the locking or overlapping of the primary wing feathers by certain birds during flight.

Attention was called to the fact that about four years ago (Oct. 17, 1887) he had read a paper before the Academy describing this locking of the primaries of certain hawks, discovered by Mr. C. C. Trowbridge, and stated that, as the number of specimens then examined was small, and although the fact of this habitual locking or overlapping, especially during soaring flight, seemed completely established for certain hawks; yet from time to time observations had been continued; a most remarkable opportunity for such observations having occurred this autumn during the month of September.

Large flights of hawks migrating southerly took place near New Haven on the 8th, 9th, and 14th of September. On those days the wind was northerly and high, and advantage was taken, for the purpose of procuring specimens, of a high hill around which hawks and eagles were circling. Large numbers passed within shooting distance, generally soaring, but frequently soaring and flapping alternately.

On September 8th nine hawks were shot, on September 9th three, on September 14th fourteen, in all twenty-six, embracing four species—the "Sharpshinned," the "Broad winged," the "Marsh," and the "Fish" hawks.

The birds were examined and notes made of the condition of the wing feathers as soon as the birds reached the ground. Of the twenty-six birds which were shot twenty-three were found to have the primaries locked or overlapped along that portion of the feathers which were emarginately cut.

Of the three which were counted as not having primaries locked, one was a fish hawk, which was at first only "wing tipped" by the shot, and which was found flapping along the ground in the undergrowth of the woods where it had fallen; and another was a small hawk which ran some distance through the bushes before being caught. The third was moulting and its primaries had only partly grown out, and but one primary was locked.

Professor Trowbridge stated that he was present during the observations of the 14th of September, and many more birds might have been shot; but he concluded that enough had been killed to confirm absolutely the facts reported at the meeting of the Academy above referred to.

The following papers were then read by MR. GEORGE F. KUNZ:

1. Some Observations on the Opal Mines of Hungary, and the Occurrence of Opal in Washington and Oregon.

2. On the Origin of Garnets and Associated Minerals in the Garnet District of Bohemia and Saxony.

Both papers being illustrated by lantern slides.

After the reading of these papers considerable discussion ensued, in which PROF. KEMP, DRS. JULIEN and BRITTON took part.

DR. BRITTON, calling attention to the approach of Christmas, moved that when the Academy adjourns on December 21st it do adjourn until January 4th, 1892. Carried.

MR. GARRETTSON called attention to the death of DR. JOHN C. JAY, the oldest member of the Academy, formerly active in the Lyceum of Natural History, and its Treasurer from 1836 to 1843. His valuable conchological collection was bought by MISS WOLFE and presented to the American Museum of Natural History, Central Park. DR. JAY became a member of the Lyceum in 1832, and died last week.

Meeting adjourned.

November 30, 1891.

STATED MEETING.

Vice-President DR. HUBBARD in the chair. About thirty persons present.

The minutes of the previous meeting (November 23d) were read and approved.

The following paper was then read, entitled:

The Clays of the Hudson River Valley.

BY HEINRICH RIES, COLUMBIA COLLEGE.

(PUBLISHED BY PERMISSION OF THE N. Y. STATE MUSEUM.)

(Illustrated by lantern slides.)

Summary of Contents.—1. General description of the clay deposits, with special reference to those at Cornwall and Thiells. Unstratified material covering the clay.—2. Delta deposits.—3. Terraces.—4. Conclusions.—5. Organic remains.—6. Concretions.—7. Tables.

A characteristic topographic feature of the Hudson River Valley between New York and Albany is formed by the natural terraces which extend more or less continuously along both sides of the river.

These terraces are underlain by three types of quaternary deposits:—

1. Drift.
2. Delta deposits.
3. Estuary deposits of fine stratified sand, and blue and buff clays.

These estuary deposits indicate a period of submergence, during which the water covering the land was very quiet.

The clays extend more or less continuously from Sing Sing to Albany, with the exception of two narrow portions of the river, viz., from Jones's Point to Cornwall and from New Hamburgh to Staatsburgh, where little or no clay is found, the terrace, if present, being usually underlain by till. Below Sing Sing the clay occurs in isolated patches of no great extent. (W. W. Mather, Geol. First District, N. Y., p. 133.)

The different members of the estuary deposits are not always present in any one spot. Sometimes only two occur, rarely only one. The clay is usually horizontal, but in a few instances dips slightly towards the river; the stratification is more distinct and the layers thinner in the buff clay. The blue is more plastic than the buff and makes a better brick. Both effervesce readily with acid from the amount of lime in them and are known as marly clays.

At most localities where the clay is exposed the blue has a greater thickness than the buff, though there are cases in which only the buff is present.

Usually the different members of the deposit are separated by well-marked lines. There are times, however, when the blue shades into the buff and the latter into the stratified sand, this being always the upper member while the blue is the lower.

At some localities the clay layers are not over an inch thick and alternate with equally thin layers of sand or sandy clay. Such alternation is found at Haverstraw, Stony Point, Fishkill, New Windsor, Cornwall, Croton, Dutchess Junction, Catskill, and Port Ewen. At all these localities except the last two we find the clay covered by or associated with delta deposits, and this interlamination of the clay and sand is probably due to variations in the rapidity of the river entering at those points.

The delta of Catskill Creek has recently been found at Leeds, some two miles back from the Hudson, and the delta of Rondout Creek will probably be found by following up that stream to the shoreline of the ancient estuary.

Ice-scratched boulders are often found in the clay, some of them six feet in diameter.

The thickness of the clay is very variable (see Table I), due to the irregular form of the underlying surface. Sometimes the clay rests on loose till, or hardpan, or, as at Glasco, on the upturned edges of the shales. At Verplank and Montrose the clay lies in basins scooped out of the rock by the glacier.

From Albany to Catskill the clay is usually underlain by modified drift of a dark gray or black color, and consisting of pebbles of shale and quartz and sand which is mostly comminuted shale. This sand is used for tempering the clay in the manufacture of bricks, but at Catskill contains too much lime for this purpose. These underlying masses of sand and gravel are probably kames; the materials composing them show a cross-stratification in many places, they having probably been deposited by the waters rushing from the glacier. At Coeyman's Landing this material is faulted in three places, and at Hudson to the rear of Fitzgerald's yard there are five faults in a space of fifteen feet.

Borings have been made in the clay at several localities, to wit: At Jover's yard near Roseton a well was sunk 175 feet through 80 feet of clay and 95 feet of sand and gravel, and this added to the height of the upper limit of the clay above river-level gives us a total thickness of 180 feet at this point. At Rose's yard to the south of Jover's, a boring was made from river-level 135 feet through blue clay, which added to the 108 feet of clay above river-level gives a total thickness of 243 feet. At Haverstraw the clay is known to extend 100 feet below river-level.

There is a very interesting clay deposit between Cornwall and Newburgh. The clay layers are in many places wrinkled and in some cases pressed together so as to obliterate the stratification. We also find several terraces of small extent at this locality, to which there are no corresponding ones on the other side of the river; and finally the clay rests on the glaciated surface of the rock.

I am inclined to think that the disturbance at this locality was produced by one or more land-slips.

At Cornwall the upper terrace is underlain by till, and this we find to be the usual succession. In only two instances was the upper terrace found to have the clay beneath.

Going further down the river we come to Haverstraw. Here we find three terraces, the upper one underlain by till containing large boulders; this drift dips under the clay, as can be seen by a section exposed at the south end of the village and to the rear of T. Chrystie's yard.

Some two miles west of Haverstraw along the N. J. & N. Y. R. R. between Thiells and Mt. Ivy is a very interesting little basin-shaped clay deposit of elliptical outline. It is not over 18 feet thick, as determined by boring. The clay is underlain by till and overlain by two to three feet of the same material containing small ice-scratched boulders. The valley in which this deposit lies contains numerous ridges of drift, whose longer axes lie parallel to the direction of the valley. A section of one of them is exposed near the clay deposit. This latter was probably formed in a small temporary lake under the ice.

At Stony Point the upper surface of the clay is very uneven and is covered by two to eight feet of unstratified material consisting of coarse sand and cobblestones. A similar deposit is found overlying the clay at Low Point above Fishkill. Also at Dutchess Junction the clay is covered by the same kind of material, this latter locality being the only one where any stratification is observable in the mass. The layers dip towards the river.

The delta deposits of the streams tributary to the Hudson are of great interest. They afford us an idea of the former size of these streams, and also indicate the amount of submergence which took place at the several points.

These delta deposits are made up of two members: 1st, the thinly stratified loamy clays which were deposited a short distance from the mouth of the river; and, 2d, the coarse, cross-bedded sands and gravels which were deposited at its mouth.

The following streams between New York and Albany have formed delta deposits (as noted by Dr. Merrill, Amer. Journ. Sci., June, 1891): Wappinger's Creek, New Hamburgh; Fishkill Creek; Quassaic Creek, Newburgh; Moodna River, Cornwall; Indian Creek, Cold Spring; Peekskill; Pocantico River, Tarrytown; Sawmill River, Yonkers; Tibbitt's Brook, Van Cortlandt; Minisceongo Creek, Haverstraw.

All of these deltas have been largely eroded by the streams which formed them, and little is left of them at the present day.

Dr. Merrill (Amer. Journ. Sci., June, 1891) considers it highly probable that some of these deltas once filled a large portion of the valley in the Highlands. At Jones's Point opposite Peekskill there is a deposit of thinly stratified loamy clay which may have formed a portion of the secondary cone of Peekskill Delta; also at Roseton there is a similar deposit which may belong to the delta of Wappinger's Creek, which discharges at New Hamburg, about one and a half miles further up the river.

In general, the upper limit of the clay increases northward, as does also the terrace-level. To illustrate the latter point, we have the following altitudes, those marked with an * being given by Dr. Merrill:—

EAST SHORE.			WEST SHORE.
Croton,	100	100	Haverstraw.
Peekskill,	120		
		185*	West Point.
		200	Cornwall.
Fishkill,	205	205	Newburgh.
		207	Port Ewen.
		340*	Schenectady.

The measurements apply to what is probably the upper terrace. At some localities we find more than one terrace, thus:—

Athens,	2. a 3?	Stony Point,	3.
Port Ewen,	2.	Peekskill,	2.
Cornwall,	3.	Fishkill,	2.
Storm King,	2.	Schodack,	2.

Table No. 2 gives the terrace measurements made at the different points along the river, and it should be borne in mind that they do not represent the highest portion of the upper terrace when more than one is present, as, especially along the upper portion of the river, the shore-line is quite a distance back.

Such, in brief, are the general relations of the deposits along the Hudson River.

As far back as 1800 Dr. Samuel L. Mitchell mentioned the Hudson River clays in the Mineralogical History of New York. In this he says: "The flats between the basaltic rocks and Stony Point at Haverstraw appear to be underlaid by argillaceous strata, which, as their edges appear along the shore, are not yet hardened enough to withstand the impression of the walker's foot."

In 1826, according to Prof. W. W. Mather (Geol. First District of New York, p. 130), Mr. John Finch described the quaternary deposits of the Hudson in a general manner under the name of tertiary.

Prof. W. W. Mather (Geol. First District of New York, pp. 123–150) in 1843 gives a general description of the quaternary deposits of this region.

In a paper published in the Amer. Journ. Sci. for June, 1891, Dr. F. J. H. Merrill expresses the following conclusions concerning the estuary deposits of the Hudson Valley:—

That after the departure of the glacier from the Hudson Valley the land was depressed for a time, this depression amounting to at least 80 feet at New York and 340 feet at Schenectady. That during this depression a great depth of clay accumulated, and over this a deposit of fine stratified sand. Dr. Merrill considers that the sand may possibly have been deposited during the emergence of the land,

and he further considers that following the submergence there was an elevation amounting to 180 feet at New York and at Albany to an amount probably not less than 350 feet and perhaps even 400 feet, and that during this elevation the estuary deposits were extensively eroded. There is then supposed to have been a second depression, which at New York amounted to 100 feet.

As far as my personal observations go, they practically confirm Dr. Merrill's conclusions. A few facts I may, however, add:—

Regarding the unstratified material overlying the clays at certain points we note the following:—

1. The materials are coarse sand, pebbles, and cobble-stones, lying mixed up together, the only locality where stratification was noticed being at Dutchess Junction.

2. The materials are of the same kind as the rocks in that vicinity.

3. The stones are rounded and water-worn and show no signs of glaciation. This material was possibly washed down into the Hudson Valley from the valleys of its tributaries by the floods which took place in the late quaternary and during the emergence of the land.

The ice-scratched boulders found in the clay were probably dropped there by icebergs floating down the estuary to the sea.

While in the field I found no fossils, but a microscopic examination of the clays has thus far resulted in the discovery of three objects:—

1. A diatom resembling a tertiary species from Richmond, Va.

2. A fragment which may possibly be a diatom or desmid.

3. Another fragment whose surface has a moniliform pattern. This closely resembles the surface-marking of the shell of a Buccinium described by Sir William Dawson from the Champlain deposits of Canada. (Canad. Nat., New Series, vol. vi.)

Concretions are very common in the clays and of varied outline. One variety found at Coxsackie has formed around the roots which penetrate the clay and resembles in form the rhizomorphs described by Dr. Northrop (Trans. N. Y. Acad. Sci., vol. x, No. 1) from the Bahamas. They may have originated in a similar manner.

In the sands overlying the clays at Croton Point concretions are common, sometimes forming masses four by six feet and several inches thick.

TABLE NO. 1.

LOCALITY.	Yard where observation was made.	Blue.	Yellow.	Height above tide of bottom of clay.	Boring showed.	Total thickness.	Thickness of covering.	Character of covering.	Character of underlying material.
Coeyman's Landing	Sutton and Suderly.	100	20	15	—	120	2–3 feet.	Loam.	Sand and gravel. Kame.
Athens	W. Ryder.	30	9	80	18	39	4 "	"	Drift?
Coxsackie	F. W. Noble.	20	15	100	—	35	2 "	"	Shale.
Catskill	Derbyshire Brick Co.	50	15	35	—	65	2–3 "	"	Sand and gravel. Kame.
Smith's Landing	T. Brousseau.	33	6	32	—	39	2 "	Loam and sand.	
Glasco	Washburn Bros.	132	4	8	—	136	6–8 "	Fine sand.	Shale.
East Kingston	F. N. Van Dusen.	45	—	34	—	45	4 "	Earth and sand.	"
	Streeter & Hendrix.	10	7	65	—	17	2 "	Loam.	"
	C. H. Littlefield.	—	—	—	40	—	2 "	"	"
	A. Rose & Co.	—	—	—	48	—	1½ "	"	"
	D. C. Overbaugh.	30	10	—	60	60	1½ "	"	"
	Brigham Bros.	—	9	80	25	—	2 "	"	
	C. A. Shultz.	80	—	20	—	80	8–10 "	Fine sand and gravel.	
Roseton	J. J. Jover.	100	—	8	80	180	8–10 "	Sand and gravel.	Limestone and gravel.
	Rose & Co.	108	—	8	135	243	8–10 "	" "	
New Windsor	—— ——	20–40	10–20	20–40	—	60	6–10 "	Sand and gravel, 6 strat.	
Cornwall	C. A. & A. P. Hedges.	44	8	16	—	52	20–60 "	Delta material.	
Haverstraw	Excelsior Brick Co.	—45	—	8	100	100	Stripped.	Fine gravel.	Drift.
	Donnelly & Son.	—45	—	—45	—	45	"	" "	"
	Lilburn's Land.	35	6	15	—	41	6–8 feet.	Sand and gravel.	"
Thiells	Felter & Mather.	6	3	—	18	9	3 "	Sand and cobbles.	"
Croton Landing	W. A. U. Brick Co.	55	—	—15	—	55	15 "	Sand; concretions.	
	Anchor Brick Co.	40	—	41	35	75	6–10 "	Sand, loam, gravel.	Hardpan cemented by clay.
Montrose	C. A. Hyatt.	40	—	—	—	40	2–10 "	Sand and gravel.	Rock.
	J. Morton.	4	4	—	—	8	8–10 "	Sand and gravel, cross-strat.	Rock.
Verplank	B. J. Maguire.	12	6	—6	—	18	6–30 "	Coarse sand and stones.	
Peekskill	Cole & Bonner.	10	4	—10	50	64	6 "	Sand and cobbles.	
Dutchess Junction	T. Timoney.	55	6–12	10	—	65	2 "	Loam and brush.	
	L. Van Buren.	66	8	10	—	74	4– 6 "	Sand and gravel.	
	Aldridge Bros. & Co.	70	—	10	65	135	8–12 "	" "	
	Barnacue & Dow.	55	10	10	—	65	6– 8 "	" "	
Fishkill	Harris & Ginley.	45	4	10	—	49	1– 2 "	Loam.	Hardpan and shale.
	Obrien, McConnell, Vahey.	26	12	9	—	38	2– 4 "	"	
	Brockway Brick Co.	18	18	10	—	36	3– 4 "	Sand.	Hardpan.
	Dinan & Butler.	36	20	9	—	56	4– 7 "	Sand and cobbles.	
Low Point	J. V. Meade.	20	8	10	—	28	1– 2 "	Loam.	
	C. G. Griggs & Co.	6	6	65	—	12	5 "	"	Sand and gravel.
Hudson	Arkison Bros.	50	25	20	—	75	5 "	"	Shale and drift [?].
Stockport	Walsh Bros.	—	25	125	—	25	2 "	"	Shale and small bowlders.
Stuyvesant	E. Brousseau.	20	20	60	—	40			

A minus sign preceding a number indicates a depth below mean tide.

TABLE NO. 2.—*Terrace Measurements.*

Measurements marked thus * are from Dr. Merrill.

WEST SHORE.	NORTH.		EAST SHORE.
Coeyman's Landing.	140	130	Schodack.
		60	
Coxsackie.	135		
		150	Stockport.
Athens.	125	100	Hudson.
	40		
	20 ?		
Catskill.	140		
Malden.	Sta.		
	84		
Smith's Landing.	75		
Glasco.	150		
E. Kingston.	160		
Port Ewen.	207		
	40		
Marlborough.	200		
	60		
Roseton.	120	185	Low Point.
		106	[Dinan & Butler.]
		84	[Brockway Brk. Co.]
Newburgh.	205	205	Fishkill.
New Windsor.	108	125	Dutchess Junction.
		120	[T. Timoney.]
Cornwall.	200	200	Storm King.
	138	150	
	60		
West Point.	185*		
Jones's Point.	120*	120*	Peekskill.
		20 ?	
Stony Point.	100	90	Verplank.
	60		
	20		
Haverstraw.	100	100	Croton Landing.
	60		

GEOLOGICAL LABORATORY, COLUMBIA COLLEGE.

Following the reading of this paper there was considerable discussion by PROFESSORS BRITTON, KEMP, MARTIN, and others.

MR. GARRETTSON offered the following:

Resolved, That a committee of three be appointed by the chair to draft resolutions relative to the decease of DR. JOHN C. JAY, of Rye, N. Y., who, on November 8th, 1891, the date of his decease, was the oldest surviving member of this Society, and to present such resolutions before the Academy at its next meeting for action.

Carried.

The Chair appointed as such committee MESSRS. GARRETTSON, BRITTON, and MARTIN.

Meeting adjourned.

December 7th, 1891.

REGULAR BUSINESS MEETING.

Vice-President DR. HUBBARD in the Chair. Twenty-five persons present.

The minutes of the Business Meeting of November 2d were read and approved.

MR. GARRETSON, Chairman of the Jay Memorial Commitee, made the following report, which was unanimously adopted:—

Resolved, That the New York Academy of Sciences receives with deep regret the announcement of the death of DR. JOHN C. JAY, which occurred at his country seat at Rye, N. Y., on November 8th of this current year. At the date of his decease, Dr. Jay was the oldest surviving member of this Society, having joined the Lyceum of Natural History fifty-nine years ago.

Resolved, That the Records and Annals of this Society bear abundant testimony to the efficient services of Dr. Jay in its behalf in his performance for many years of the duties of Treasurer of the Lyceum, and to his substantial aid and wise advice afforded it in times of financial difficulty.

Resolved, That the Academy recognizes the eminent services rendered by Dr. Jay to the cause of science in his specialty as a conchologist, through his labors in the collecting, classifying, and cataloguing of mollusca in the celebrated "Jay Collection" and the gathering together of extensive and valuable literature connected with the subject.

Resolved, That the Academy and the public have cause for congratulation in the fact that the results of Dr. Jay's labors will live as a monument to his name and usefulness by the deposit with the American Museum of Natural History in this city of "the Jay Collection of Shells" and the catalogues and literature connected therewith—all of which were purchased from Dr. Jay by the late Miss Catherine Wolfe, and by her generously presented to that institution for the benefit of posterity.

Resolved, That these resolutions be recorded in the minutes of the Academy, and a copy of the same be furnished by the Secretary to his son, Dr. John C. Jay, Jr., of this city, to be received by him in behalf of the family of our deceased member.

The following persons recommended by the Council were elected Resident Members by ballot:—

STEPHEN P. NASH,
DR. J. ADELPHI GOTTLIEB,
CHARLES RIBORG MANN,
PROF. HENRY F. OSBORN.

NEW YORK ACADEMY OF SCIENCES.

Late LYCEUM OF NATURAL HISTORY.

Organized 1817.

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1891-1892.

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[*Continued on page* 3.

MR. FRANK M. CHAPMAN was nominated as a Resident Member by PROFESSOR J. A. ALLEN.

The Astronomical Section then organized, PROFESSOR J. K. REES in the chair. MR. JACOBY, the Secretary, read the following papers by title:

I. Transit Factors for the Observatory of Columbia College.

BY J. T. MONELL AND C. R. MANN.

II. The Rutherfurd Photographic Measures of the Group of the Pleiades.

BY HAROLD JACOBY.

The following papers were then read, entitled:

Report upon the Meeting of the National Academy of Sciences.

BY HAROLD JACOBY.

(Abstract.)

At the meeting of the National Academy of Sciences held at Columbia College, November 10th to 12th, the following papers of a mathematical nature were read: Certain New Methods and Results in Optics, by Professor Charles S. Hastings; New Pendulum Apparatus, by Professor T. C. Mendenhall; Astronomical Methods of Determining the Curvature of Space, by Professor C. S. Peirce; Variation of Latitude, by Professor S. C. Chandler; Color System, by Professor O. N. Rood; Reduction of Rutherfurd's Photographs, by Professor J. K. Rees; Measurement of Jupiter's Satellites by Interference, by Professor A. A. Michelson.

Professor Hastings's paper contained some new and very simple demonstrations of optical formulæ already known, as well as certain important formulæ altogether new, including a general expression for magnifying power applicable to *both* telescopes and microscopes. Professor Peirce presented astronomical evidence tending to show that space possesses a negative curvature, and called attention to various methods of conducting an investigation of this property of space. Professor Chandler exhibited curves showing that the recently discovered variation of latitude could be made to explain certain hitherto unaccountable discordances in older observations. His paper was followed by considerable discussion among the astronomers present, Professors Young, E. C. Pickering, C. S. Peirce, Abbe, and Dr. Gould taking part. The chief question debated was whether the variation has a *terrestrial* or *celestial* origin. The investigations are being published in the *Astronomical Journal.*

Professor Michelson described his recent measurements of Jupiter's satellites at the Lick Observatory, and thought that we may hope to measure the angular diameters of some of the brighter stars, if they be as great as the hundredth part of a second of arc. His paper was perhaps the most important one of the session. In it was presented a new method of measuring the angular diameters of luminous discs by means of the interference phenomena produced by them. The experiments made at the Lick Observatory have been described in the *Publications of the Astronomical Society of the Pacific.* The 12-inch telescope was used, but a telescope is by no means indispensable for these observations, the chief requisite being a very favorable condition of atmosphere. It is to be hoped that these very promising researches will be continued.

III. Changes on the Lunar Surface.

BY J. K. REES.

(Abstract.)

Professor Rees first presented briefly the various reported discoveries of changes on the lunar surface, making especial mention of the case of Linné. He then stated the case of Hyginus N. "Let us recapitulate the present state of this most important question. In the central regions of the moon, where libration has no sensible effect in altering the appearance of the lunar surface, there is a comparatively open region which has been often studied. Schröter, Lohrmann, Gruithuisen, Beer and Mädler, Schmidt, Klein, Neison, have all made this region the object of special study, so that it has been repeatedly examined with most powerful instruments. A great number of very small crater-hills and ridges have been seen, and all drawn and mapped. A smaller number of larger craters and hills have also been seen, and every one which existed has been mapped. So often has this region been studied, that several years ago it was pointed out as being one of the very few regions in which if a change occurred it would be possible to prove it.

"What do the present observations show? This, that in the very midst of this region there now exists a big black, rounded spot, perhaps a crater, perhaps merely a depression, possibly only a surface marking, but in any case so large and conspicuous as to be almost the most distinct object in the entire region. We know that the minuter features shown on the maps and drawings made anterior to 1876 could only have been seen and drawn within forty-eight hours of sunrise and sunset. We know, moreover, that most of these drawings were made shortly after sunrise Yet the present observations would indicate that now, whenever these smaller details are visible, there, in their very midst, stands this great black object. For more than thirty-six hours after sunrise this black, crater-like object appears to be now always visible. Before 1876 it was never to be seen; since 1877 it is never to be overlooked. Wherefore?"

This was the statement of the case in the *Selenographical Journal* for June 19th, 1879. Thereafter the *Journal* published numerous drawings showing Hyginus N. In various astronomical papers and journals is to be found frequent mention of this interesting question.

At the meeting of the Royal Astronomical Society of London, in April, 1882, Mr. Neison gave a succinct account of the observations made by himself and others on this portion of the moon. He believes the marking new, and says: "What its real nature is—whether it is a volcanic elevation, whether it is a break down, whether it is a black surface, or what it is—I do not know; but it is a certain black object which was not there when I observed it before 1877, when Prof. Schmidt and Dr. Klein observed it, who could not have overlooked it if it had been anything as distinct as it is now. Although there are very many drawings of that part of the moon, there is not a single one that shows it."[1]

Although the evidence brought forward is considered very strong and appears almost like proof of a change in lunar marking, yet astronomers have not regarded the evidence as sufficient; the pith of their objection being that "when your attention is directed to a thing, the thing is easily seen."[2]

I was encouraged to take up this question by the Director of the Lick Observatory, Prof. E. S. Holden.

Knowing that the Columbia College Observatory had received from Mr. Rutherfurd all his lunar photographs, most of them taken before 1876, Prof. Holden suggested that we were the only persons in the world who possessed the requisite material for settling the question.

Our first examination was as to whether the photographs taken during the past few years show the marking Hyginus N.

This was answered in the affirmative. The photograph taken August 15th, 1888, by Prof. Holden, and the photograph by W. H. Pickering in 1889, showing Hipparchus and the surrounding region, seem to me to show plainly the marking. Being satisfied that the marking can be photographed, I next examined a number of *positives* made by Rutherfurd; these were sealed and could not be examined as closely as desired. On the positive taken September 16th, 1870, there appears to be a dark marking in the place where Hyginus N. shows itself in the later photographs. The phase is not the best suited for such examination. This marking was also seen by Mr. H. Jacoby. I find, too, in "Poetry of Astronomy," by R. A. Proctor, on page 240, that he examined several photographs of the moon by Rutherfurd, and thought he saw on the positive of September 16, 1870, Hyginus N.

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[1] The Observatory, No. 60, 1882, p. 102.

[2] Remark by Prest. Stone, R. A. S. Observatory, No. 60, p. 105.

This examination seems to show it will be desirable to make positives from all of Rutherfurd's negatives of the moon when her age was less than thirty-six hours greater than the first quarter.

Such an examination will be begun very shortly.

Meeting adjourned.

December 14th, 1891.

STATED MEETING.

Vice-President DR. HUBBARD in the chair. About fifteen persons present.

The minutes of November 30th were read and approved.

The following paper was read, entitled:—

The Railway Problem in China.

BY JOHN A. CHURCH.

(No abstract.)

At the close of this paper, the Academy adjourned to the Chemical Lecture-Room, where the following papers were read, entitled:—

A new form of Vacuum Tube, and A new Electrodynamic Current Interruptor, both by DR. M. I. PUPIN.

No Abstract.

December 21st, 1891.

STATED MEETING.

Vice-President DR. HUBBARD in the chair. One hundred and fifty persons present.

The minutes of December 14th were read and approved.

PROF. D. S. MARTIN announced that during the coming week an exhibition of geographical apparatus, maps, charts, globes, etc., would be opened at the Arsenal Building in Central Park. The exhibition would remain open for two weeks, and members of the Academy were invited to attend.

DR. HUBBARD exhibited the following early and interesting works on North American Geology :—

Wm. Maclure's Geology, with a section map from St. Louis to the Atlantic Ocean, through Philadelphia, published in 1817.

The Van Rensselaer Canal Survey, by Prof. Eaton, of Troy, with a section from Boston to Niagara, published in 1825.

Prof. Mitchell's Geology of North Carolina, 1842.

Meeting of Geologists in Philadelphia in 1840. DR. HUBBARD stated that he had been present at that meeting.

The third lecture of the Popular Course was then delivered by PROF. H. L. FAIRCHILD, of Rochester University, entitled :—

Mountains, their Origin and History,

illustrated by lantern views.

At the close of the meeting a vote of thanks was passed to the lecturer, and the Academy adjourned until January 4th, 1892.

January 4th, 1892.

REGULAR BUSINESS MEETING.

Vice-President DR. HUBBARD in the chair. Ten persons present.

The minutes of the previous Business Meeting (December 7th, 1891) were read and approved.

MR. FRANK M. CHAPMAN, having been recommended for election as a Resident Member by the Council, was duly elected by ballot.

The following persons were proposed as Resident Members, viz :

J. WOODBRIDGE DAVIS, Ph.D., by H. JACOBY, ISRAEL C. PIERSON, Ph.D., by J. J. STEVENSON, and referred to the Council.

The Astronomical Section then organized, PROF. J. K. REES in the chair. The Secretary of the Section read a communication from COUNT E. V. HESSE-WARTEGG, who was expected to lecture upon "The Progress of Standard Time in Europe." The Count was unable to be present, as he had been summoned to Spain by cable on important business of his government.

Remarks were made by PROF. REES upon Standard Time, and letters were read upon the same topic from COUNT HESSE-WARTEGG, DR. ROBERT SCHRAMM, of Vienna, and MR. ALLEN.

From the latter the following communication was obtained:—

We are informed by Prof. Pasquier, of the University of Louvain, that M. Vandenpeereboom, Minister of the Department of Railway, Postal and Telegraph Lines of Belgium, has decided to introduce the use of the Standard Time of the Greenwich Meridian on May 1, 1892, in all services in his department. He also recommends its adoption by the other departments in their relations to the public. This is a great step in advance toward the unification of time throughout all the world.

The situation in other countries, as briefly set forth by Prof. Pasquier, has been published in the "Annales de la Société Scientifique," of Brussels, from which we extract the following:—

In Holland the government has authorized the use of Standard Time of the Greenwich Meridian for the operation of railways from May 1, 1892, the same date as for Belgium. On the time tables for the use of the public, for the present, local time will be used.

In Prussia "Middle European Time," one hour faster than Greenwich time, was adopted on June 1, 1891, for employés' time-tables. At the meeting of the German Railway Union, held last year, the Prussian delegates opposed the adoption of this standard for public time-tables, but they have now themselves proposed its adoption for the use of the public also. A speech made by Field-Marshal Von Moltke in the Reichstag shortly before his death appears to have been a moving cause of this change of opinion. At the meeting of the "Union" in July, 1892, the general adoption of Standard Time for all railway tim-etables in Germany is likely to be accomplished, and its use in civil life will probably follow.

The governments of the South German States (Bavaria, Wurtemberg, and Baden) have decided to adopt the "Middle European Time" for all railway time-tables on April 1, 1892. Its introduction in Alsace-Lorraine will be effected on the same date.

Since October 1, 1891, the same standard time has been in use in all railway, postal, and telegraph service in Austria-Hungary, and many Austrian cities have also adopted it. Dr. Peez, a member of the Chamber, presented, at the meeting of May 11, 1891, in the name of twenty-nine of his colleagues, a petition asking legislation authorizing the extension of the use of the new time for civil life throughout the entire empire.

It appears quite probable that by the winter of 1892, or not later than the summer of 1893, the unification of time in all the countries mentioned, on the same principle of standard time now in use in this country, will have been completed.

The following letter was read by MR. JACOBY:—

Dr. B. A. Gould, president of the American Metrological Society, writes from Germany that at the quinquennial session of the Geographical International Congress held in Berne, August 10 to 17, there were about two hundred and eighty delegates and representatives from all countries. At this Congress was passed the following resolution on August 14th:—

"The Geographical Congress entreats Englishmen of science to desist in future from the use of their ancient units of weights and measures in scientific and technical publications, and to employ those of the metric system only."

This resolution was passed with immense enthusiasm; the applause and cheering lasted for nearly five minutes, and the vote was unanimous.

In connection with this, allow me to state that the American Metrological Society has prepared a petition asking Congress to pass the following act:—

"That on and after July 1st, 1893, the metric system of weights and measures authorized by the act of Congress approved July 28th, 1866, shall be used exclusively in the customs service in the United States."

Such petition we desire to circulate widely amongst those desiring to sign it, and we ask each signer to mail it to his Representative in Congress.

The American Metrological Society has prepared a simple and excellent chart of the metric system, which, for educational purposes, it will mail to any one asking for it for the cost price, 10 cents in stamps. Address Secretary of American Metrological Society, No. 41 East 49th Street, New York City. Copies of the petition can be had at the same address.

JOHN K. REES, *Secretary Am. Met. Society.*

NEW YORK, Sep. 24, 1891.

The Secretary of the Section announced the discovery at Heidelberg of two minor planets by photography. He also, upon the request of PROF. MARTIN, made some remarks upon the Secular Variation of Latitude.

Meeting adjourned.

January 11th, 1892.

STATED MEETING.

Vice-President DR. HUBBARD in the chair. Twenty-five persons present.

The minutes of December 21st, 1891, were read and approved.

The following paper was read, entitled:—

The Natural Dyes as Applied to Wool.

BY H. T. VULTÉ AND D. W. WARD.

This paper will appear in the May number.

At the close of the paper the meeting adjourned.

January 18th, 1892.

STATED MEETING.

MR. F. W. GARRETTSON in the chair. One hundred persons present.

The minutes of January 11th were read and approved.

The fourth lecture of the Popular Course was then delivered by PROF. FRANKLIN W. HOOPER, of the Brooklyn Institute, on

The Lochs and Crannogs of Scotland,

illustrated by lantern views.

From the deductions of PROF. HOOPER, the ancient Scottish Race, the Picts, resisted successfully the invasion of Roman, Northman, Dane, and Saxon arms; their peculiar manner of building these lake homes, and the engineering skill displayed in the construction of the Crannogs, together with the implements found in their ruins, mark them as a people of no small degree of civilization. These lake dwellings have been found in almost every quarter of Scotland, and when fully investigated will probably throw much light on this unconquerable race.

Meeting adjourned.

nsactions of the New York Academy of Sciences,
Vol. XI, pp. 49–58.

To replace pp. 49–58 of Nos. 3, 4, 5, 1891–1892.

January 25th, 1892.

STATED MEETING.

Vice-President DR. HUBBARD in the chair. Eighteen persons present.

The minutes of January 18th were read and approved.

A letter was read from DR. JOHN C. JAY, Jr., thanking the Academy for the Resolutions adopted in memory of his father, the late DR. JOHN C. JAY.

DR. BOLTON announced that an illustrated lecture would be delivered before the Brooklyn Institute of Arts and Sciences by PROF. CHARLES V. RILEY, Chief of the Division of Entomology, U. S. Department of Agriculture, on Tuesday, March 2d, 1892.

Insects and flowers; or, the Interrelations of Insects and Plants.

Members of the Academy were invited to attend.

The following paper was then read, entitled

The Origin and History of Mineralogical Names,

BY ALBERT H. CHESTER,

with an exhibition of classical works on Mineralogy.

The study of mineral names is an interesting one, not only from the mineralogist's point of view, as affording an insight into the growth and development of this branch of science, but also to the student of human nature, for many traits of character are shown in the various considerations which have determined the particular name to be adopted.

We sometimes find as a reason for a name the simple idea of distinguishing the thing itself; but this is not the most common reason. To do honor to some person who may perhaps be pleased or flattered by the attention, or to immortalize some place, often otherwise obscure or unknown, is a much more common reason. Names have been given to commemorate battle-fields, to sneer at the work of earlier investigators, and as a tribute to feminine loveliness. In short the whole round of human passions has been gone over in the manufacture of these words, which are purely scientific in their uses, and for the making of which scientific methods might well have been employed. The subject has also no little interest from the philological side, and these names deserve study if only as part of language. I need make no excuse for occupying your thoughts for a short time in the consideration of this general subject.

One of the most noticeable things about mineral names is the lack of uniformity in their terminations. While the large majority of them end in -ite, there are many in -ine, while -ane, -ase, -ose, and several others have been often used. It is to be regretted that the termination -ite has not been universally adopted, for it has been so far adopted as to be the generally accepted one for such names. It has the sanction of antiquity, for it was used by the old Greek writers in the forms -ites, or -itis, as in ἁιμᾰτίτης, 'hematite,' and ἀλαβᾰστίτισ, 'alabaster.' Such forms were also used by the Romans, and we have in Pliny siderites, 'lodestone,' steatitis, 'soapstone,' molochites, 'malachite,' and many others. These forms are undoubtedly the source of the termination -ite now in use, as they are the earliest known terminations. Such names were given by the ancients as noting some property or use of the mineral, or sometimes designating its source, or the locality from which it was derived; as μαγνῆτις, a mineral from Magnesia. Or, to speak of those already mentioned, ἁιμὰτίτης is a mineral resembling blood, from the color of its powder; ἀλαβαστὶτις, a mineral from which a vessel called an alabastron was cut, siderites, from σίδηρος, 'iron,' because it contains it, steatitis, from στέατος, 'of fat,' because it feels greasy, and molochites, from μὰλάχη, 'mallows,' alluding to its green color.

All scientific works were written in Latin up to a very recent date, and as there was no chemistry to show differences in composition, there was no real progress in mineralogy. External characters alone were used as means of distinguishing minerals from each other, and those that looked alike must necessarily be classed together. Pliny's names were sufficient for all the uses of science down to the 16th century. There had hardly been a name added, even by Agricola, whose large works were published 1529 to 1546. The name fluor is perhaps his only new one, and that he probably did not originate, but took from the vocabulary of the furnace-men, who used it in smelting their ores. Certain minerals in general use had their common names in various languages, but there were few of these.

The use of the termination -lite, in German -lith, from the Greek λίθος, 'a stone,' ought here to be mentioned, as it was a genuine attempt to introduce a distinguishing mark for mineral names, which, if successful, would have been of great benefit to mineral nomenclature, as bringing in the desirable element of uniformity. This also comes from antiquity, being found in the Greek. But it never came into general use, and in later years is hardly used except for euphony. There is an erroneous impression that the termination -ite is derived from this, which, as we have seen, is not the case, being a much older form.

Several attempts have been made to give systematic names to minerals on some such principle as is used in other branches of natural science, but none of them have been generally adopted, and all have by degrees been dropped. One of the earliest of these was by Sir John Hill, in his History of Fossils, 1748. He divides minerals into numbered series, classes, and orders, and under these into named genera and species. His genus names are many of them new, but are sometimes older names modified to suit his system. For instance, Marmora, for the marbles. A good example of his new names, and also of the way in which species were multiplied, when only external characteristics were considered, is in the order of inflammables. The 3d class is called Phlogoniæ, and under this we have as the 1st Genus, Pyricubia, and under this two species—

1st. Pyricubium maximum foliaceum, and

2d. Pyricubium solidum minus.

The first of these species is simply cubical crystals of iron pyrites, striated by oscillation toward a hemi-tetrahexahedron, and the second is the unstriated crystals of the same. Octahedral pyrite is made another genus, and dodecahedral is still another. Several more genera are made from what is now the one species. This system never came into general use, and Hill himself gives it up and adopts one much more simple in his later work, 1771.

In 1820 Prof. Mohs brought out a small book entitled "The Characters of the Classes, Orders, Genera, and Species; or the Characteristic of the Natural History System of Mineralogy. Intended to enable students to discriminate minerals on principles similar to those of Botany and Geology." This system is more fully presented in his larger work of 1822–24, translated by Haidinger in 1825. He uses genus and species names for each mineral, and sometimes adds a third for more careful distinction. Under the genus garnet he gives Pyramidal Garnet, or idocrase; Dodecahedral Garnet, or true garnet, and Prismatoidal Garnet, or staurolite. Dioptase becomes Rhombohedral Emerald-Malachite. This system was quite popular for a time, and had several imitators. Prof. C. U. Shepard adopts Mohs's system, and in the first edition of his mineralogy, 1832–5, he not only uses his names, but extends the system still further. He, however, gives the common, or trivial name as it is called first, and always uses them in speaking of the species. Microlite is the one new species of his own noted in this book, which under the system he calls Octahedral Tungstic-Baryte, and similar names are carried all the way through. None of these names are mentioned in his third edition, 1852–7.

In 1836, Prof. J. D. Dana read a paper before the New York Lyceum of Natural History, entitled "A New Mineral Nomenclature," in which he presents a complete arrangement according to the Natural History method, and gives some very good reasons for its adoption. This system is carried out in full in the first edition, 1837, of his great work on Mineralogy. He uses in general two names for each mineral, as Andalusius prismaticus for andalusite, but he gives the common name first in all cases. In his second edition, 1844, he retains these Latin names as the scientific ones, as necessary to "a systematic idea of the science," but adds, "the shorter trivial names should, however, be retained, as more convenient for common use." In the third edition, 1850, however, Prof. Dana discards the whole system, not even retaining the names as synonyms. A system of arrangement was adopted that was understood to be temporary, while at the end of the work a chemical classification was suggested. In the later editions, this last has been perfected, and we now have an arrangement easy of reference and answering all purposes of classification, but from which all traces of the double Latinized forms of the Natural History methods have disappeared. This or some similar system is now generally followed by writers on mineralogy, much to the satisfaction of those who use their works. In 1847, Glocker published his work entitled "Generum et Specierum Mineralium Synopsis." This is perhaps the most successful attempt at a systematic nomenclature that has been made. He uses in general a Latinized form of the common name for the name of each species, with some descriptive word added. For varieties, he adds a third word, as is common in other branches of natural history. For instance, under Granatus, garnet, he gives three species: 1st. Granatus nobilis, precious garnet; 2d. Granatus hyacinthinus, cinnamon garnet; and 3d. Granatus vulgaris, common garnet, and under the latter, the varieties Granatus vulgaris *fuscus*, *niger*, *viridis*, *flavus*, and *albidus*. The work is in Latin, thus going back to the style of the scientific books of the last century. Recently, Prof. T. Sterry Hunt has devised a new Natural System, suggested indeed as early as 1853, but as he does not give us new names for the species, a discussion of it would be out of place here. His work is, however, exceedingly interesting, and will well repay examination by those who care to go further into that side of the general subject.

In 1728 Dr. John Woodward published a work entitled "Fossils of all Kinds Digested into a Method, Suitable to their Mutual Relations and Affinity," but it is a description from external characters only, and can hardly be called a scientific treatise. The first one that really deserves such a name is by the Swedish mineralogist, Wallerius, in 1747, which is arranged on a scientific plan, and gives us the earliest systematic description of minerals. Cronstedt, another Swedish chemist, ten years later gave us a work of much greater value, as he brought in chemical relations, as far as was possible in the crude state of that science. But few new names were added, for the study was still largely from the external side, and new species could not be recognized. With the discovery of oxygen in 1776, and the real beginning of the science of chemistry, a more correct basis for the differentiation of mineral species was found. This was aided by the application of scientific crystallography, the first edition of Delisle's work appearing in 1772, and the second, in four volumes, in 1783. From this date new names were given to minerals as the result of more extended research in this branch of study, and one of the first of these was prehnite, given by Werner to a mineral brought from the Cape of Good Hope by Colonel Prehn, and hence named after him. Werner first announced the name in his lectures in 1783, as he himself states later, but it was not published for several years. In 1789 there is an article in the Journal de Physique, by Sage, objecting to the use of names of persons for minerals, the text for which is this name of Werner's. But the name has kept its place, and is now the accepted one for the species. Other names, given about the same time after persons, are Witherite, after Dr. Withering, who first described it, and torberite, later changed to torbernite, after Torbern Bergmann, its first analyst. This latter mineral has gone through various vicissitudes as to its name, and a list of them, as an illustration, may not be out of place here. I take them from the 5th edition of Dana's Mineralogy, p. 585; Mica viridis, 1772; Chalkolith, 1788; Torberite, 1793; Uranglimmer, 1800; Torbernit, 1803; Uranite, 1814; Uranphyllit, 1820; Copper Uranite (no date); Cuprouranit, 1865.

My study of the history of mineral names was begun in the interest of Murray's English Dictionary, where these names are considered as words simply, and part of the language, as found in books. The information sought with reference to each is 1st, the author of the name; 2d, date of first publication; 3d, reference to original publication; 4th, first form, if different from the form now used by English writers; 5th, derivation; 6th, reason for the name; 7th, a short description, sufficient to identify it, particularly if the name has been used for more than one species or variety.

A good example is Erinite, a name given by Haidinger, 1828, Annals of Philosophy, 2d series, vol. iv, p. 154, from Erin, because it was supposed to have been found in Ireland. It is a green, fibrous, arseniate of copper. This description is necessary, and sufficient to distinguish it from Erinite of Thompson, 1836, Thompson's Mineralogy, vol. i, p. 342, derived also from Erin, for the same reason, and properly so, for it came from Ireland. But this is a reddish, clay-like mineral from the Giant's Causeway, and probably does not merit a name at all. Full information about the majority of the names is easily obtained, and is usually to be found in the last edition of Dana's Mineralogy, up to 1892. In his 5th edition Prof. Dana makes an attempt at uniformity of nomenclature by changing the terminations of many of them into -ite, particularly those ending in -ine, only leaving those unchanged which had come into too general use in the language to be so treated. So we have galenite, alabandite, pyrrhotite, and periclasite, instead of galena, alabandine, pyrrhotine, and periclase. These changes have been generally adopted, and are all in the right direction.

In 1876 Prof. Shepard published a "Catalogue of Minerals found within about 75 miles of Amherst College, Mass.," in which he proposed that the names of all acknowledged mineral species, except those of the elements and a very few more, shall uniformly end in -ite, and that the termination -ine shall as uniformly be used for all variety names, and those whose specific character is not fully settled. Accordingly, he gives us gypsite, serpentite, wadite, orthoclasite, spodumenite, epidotite and many similar changes, while marmolite, picrolite, nacrite, and others are made to end in -ine, marmoline, picroline, nacrine. It is hardly necessary to say that these suggestions have not been generally or fully accepted.

With reference to a considerable number of names the full information wanted is not easy to obtain, and in some cases perhaps it cannot be found at all. When it is not given in Dana's Mineralogy the student may be sure that he will have to hunt to find it. This is particularly true of obsolete names, information about which must be sought in the earlier volumes of scientific journals.

The first publication of Taylor's name killinite is in 1818, in vol. xiii, p. 4, of the Transactions of the Royal Irish Academy, a fact not stated in any work on mineralogy, as far as I have examined them. There are some names also about which very erroneous ideas as to derivation prevail, and which need correction. The name chabazite was given in the form chabasie, by Bosc d'Antic, in 1780, Journal d'Histoire Naturelle, vol. ii, p. 181, and is derived from χαβάζιος, the name given to one of the stones mentioned in the Orphic poem Περί λίθον. The name as we now have it in the poem is χαλάζιός, and the mineral should therefore have been called chalazite. Kidd called attention to the blunder in 1809, Kidd's Mineralogy, vol. i, p. 249; but the original name has held its place. It is but fair to say that the form χαβάζιος was used in the current editions of the poem at the time the name was applied. The derivation of the word datholite has often been incorrectly given. It is really a corruption of the original name datolith, given by Esmark in 1806, from δᾰτέομαι, to divide, and λίθος, alluding to the granular structure of one of its varieties. Werner added the h for no apparent reason, and the changed form was adopted by most authors until Prof. Dana unriddled the matter and gave it its correct form again. But wise writers have tried to find another derivation for it, and one author of note says it is from δάθος, which he says means turbid, because the mineral is not clear and transparent. Another wiser one says there is no such Greek word as δάθος, which is true, and that it is from the compound word δα-θολλος, meaning very turbid, which is no more a proper derivation than the other. The word feldspar has been changed into felspar for no better reason than that the latter form was thought the right one. It was used by Wallerius in his Mineralogy of 1747, p. 65, in the Swedish form felt-spat, meaning field-spar. It did not originate with him probably, but may have been a popular name in his time. Da Costa used it in 1757, in the German form feld-spath, and this form was current until 1794, when we find, in Kirwan's Mineralogy, vol. i, p. 317, the following note: "This name seems to be derived from fels, a rock, it being commonly found in granites, and not from feld, a field; and hence I write it thus, felspar." This assumption of Kirwan has been taken for fact by all English writers, and the corrupt form is in very general use.

The point most commonly lacking is the reason for adopting the name. Where it is for some characteristic of the mineral the author often takes it for granted that it is as evident to others as to himself. The name coracite, Le Conte, Amer. Jour. of Science, 2d Series, vol. iii, p. 117, is a case in point. Le Conte does not give any derivation, but it is the name of a pitch-black variety of uraninite, and is probably derived from κόραξ, a raven. A similar case is that of adinole; Beudant's Mineralogy, 1832, vol. ii, p. 126. No derivation is given, but it may easily be conjectured from the description that it is from ἀδινός, compact. But there are other cases where there is nothing suggestive in the description, and even conjecture is at fault. Such conjectures if stated as such are of value, but to give them as facts, as has often been done, is certainly a serious blunder, if not something worse. Yet this has often been done. In one of the large dictionaries we find the name acanticone derived as follows: From "Greek ἀκή, point, ἀντί, against, and κῶνος, cone." This is a mere guess. The name was given by d'Andrada, 1800, Journal de Physique, vol. ii, p. 240, in the form akanthicone, and is derived from ἀκανθίς, a gold-finch, and κονία, powder, because the color of the powdered mineral is yellow. A similar blunder is made with the name alvite, so called after one of its localities, Alve, Norway. In the dictionary it is derived from alvus, the belly. Another instance of a mistaken popular derivation is that of coreite, an obsolete synonym of agalmatolite, from the name of the country Corea, probably because agalmatolite is from China, and Corea is close by. The name was given by Delamétherie in 1795, and he derives it from χοίρειος, of a swine, because of its greasy appearance. He at first calls it koireiite, but changed it to koreiite, and then to koreite, with a k, which has since been changed to c, giving the form resembling one derived from the name Corea. But the name ought to be choireiite, commencing with ch.

Sometimes errors of the compositor have failed of correction, and the changed names have found their way into later books as real ones. One of these is glorikite; Dufrenoy's Mineralogy, 1859, vol. iii, p. 326, which is an error for glinkite. Gibsonite, in the 1847 edition of the same work, vol. iii, p. 761, is probably an error for gibbsite, but this is not so clear. Galadsite, galadstite, and galadtite are all printer's errors for galaktite.

A curious case of this sort is seen in the various forms of the word didymite. It was announced by Schaufhautl in 1843 from δίδῠμος, a twin, because it was thought to be a second silicate containing calcium carbonate as part of its composition. The form was by some blunder given as didrimite, but this was soon changed by the author himself to the correctly derived form, didymite, the original ῠ being properly changed to y. Of this word you will find in the books four different forms, only one of which deserves any place in mineralogy.

Breithaupt gave the name kupholit, from κοῦφος, light, and λίθος, to a very light variety of serpentine. He leaves out the o of the original word, probably because the word with the o had been used before, being an obsolete synonym of prehnite. This was first changed to kuphoite and then to cyphoite, which gives little idea of its original derivation and meaning.

Many more instances might be cited, but enough has been said to show how much confusion has arisen through carelessness or unwarrantable assumption, and how desirable it is that it should be disentangled as far as possible.

The first requisite for this work was to get as complete a list as possible of the names. This was compiled from many sources, as no published list containing all the names was to be found in the books. This list was then written in alphabetical order in a book with space between the names for the facts to be noted, and plenty of space in which to insert omitted names. All the books at command were then looked through in chronological order, and facts inserted in their proper places as fast as found. In this way all desired information was obtained and collated about the great majority of the names, but a number were left either entirely blank or with space only partially filled. Then the words were taken one by one, in order as written down, and the lacking matter filled out as far as possible. In this way the work has progressed through the letter G, which accounts for the fact that most of the names cited come in the earlier part of the alphabet. But there are a number still incomplete, and it is partly in the hope of obtaining information about some of these that this preliminary paper has been prepared.

Of Ainalite and several other words I have not found the derivation. They are given by Nordenskiöld, and probably the information is to be found in his Mineralogy of Finland, but I have not been able to see a copy of it. Albertite is a name that needs a father and a first reference. Anagenite as a name for chrome ochre seems to have no authoritative beginning. Aricite, a synonym of gismondite, is in the same position. Aspidelite of Weibye has only the author's name after it. Barettite, Beffonite, Beudantite as a synonym of elæolite, Bieirosite, Bischofite as a synonym of plumbogummite, Braardite and Bromlite are also more or less lacking. Bromlite and some others can be cleared up by consulting the Records of General Science, a journal published by Thompson in 1835 to 1836, but I have not yet found a copy of it. These twelve names in A and B are all that are wanting to complete the information about the six hundred names catalogued under those letters; and the other letters have about the same proportion. Any information about these names or the books mentioned will be gladly welcomed.

One other word I wish to speak of, and that is dragonite, an early synonym for rock crystal. No suggestion is to be found as to its author or derivation, and yet it is mentioned in many books. The earliest mention I have found of it is in Zappe's Mineralogisches Hand-Lexicon published in 1817, where it has the form dragomit, probably a typographical error, as everywhere else it is spelled with an *n*. Zappe says the name refers to rounded or rolled quartz crystals, where only traces of the columnar form can be detected. It is easy to conjecture that this word is from draconis, of a dragon, and that such specimens were thought to have some relation to the fabulous monster, but without more light on the subject nothing positive can be affirmed. But having carried you back to the age of fables, I had better close, lest you think me wandering from my subject.

NOTE.—Since the above paper was presented, the name dragonite has been completely traced back to Pliny's *Draconites*, the so-called stone of the Flying Dragon.

The paper being concluded, DR. BOLTON stated that the Library Check-list in Bolton's Catalogue, to which the speaker had referred, was compiled by a clerk in the Smithsonian Institution, and his work was unfortunately rather carelessly done. He, DR. BOLTON, would not like to be held responsible for it. DR. BOLTON said he had read in Alchemy for Murray's Dictionary and contributed about four hundred words. Murray's monumental work is not free from errors in chemistry, *benzine* and *benzene* being confounded, for example.

DR. BOLTON directed the attention of PROF. CHESTER to several early dictionaries of chemistry that might be useful to him in his research, viz.: William Johnson's London, 1652; Martin Ruland, Frankfurt, 1612; and Sommerhoff's Lexicon, Nuremberg, 1701.

He also exhibited a copy of Bruce's American Mineralogical Journal, New York, 1814, a work of great rarity. PROF. G. BROWN GOODE had stated in print that only two copies of this journal are known to exist, one in N. Y. State Library, and one in Harvard Library (Proceedings, Biol. Soc. Washington, vol. iv, 1886–88).

DR. BOLTON also exhibited a copy of the Memoirs of the Columbian Chemical Society, Philadelphia, 1813, a book of peculiar interest and but little known.

In reply PROF. CHESTER said the Library of Hamilton College also possessed a copy of Bruce's Journal, and MR. KUNZ stated he too owned a copy.

MR. KUNZ spoke of his connection with the Century Dictionary, and of a controversy on paper he had concerning the true nature of "Rhinestone," a lexicographer of eminence claiming it to be quartz, whereas it is known to be paste.

DR. BRITTON asked PROF. CHESTER whether any definite date could be assigned to the beginnings of mineralogical nomenclature; botanical terminology dates chiefly from Linnaeus. PROF. CHESTER replied that, after Pliny, perhaps Agricola was the first authority, and that in Agricola's work he had found only one new name, *fluor*. Minerals began to be scientifically differentiated about 1780–1790, and systematic nomenclature of minerals probably dated back to this epoch.

After some remarks by DR. HUBBARD the meeting adjourned.

February 1st, 1892.

REGULAR BUSINESS MEETING.

Vice-President DR. HUBBARD in the chair. Eighteen persons present.

The minutes of January 4th were read and approved.

PROF. THOMAS EGLESTON reported, on behalf of the Audubon Monument Committee, that $9004 had been subscribed, of which about $250 would probably never be paid. He then introduced the following resolutions, which were adopted:—

Resolved, That the Audubon Monument Committee have power to erect the monument to Audubon, and to make the proper arrangements for the ceremonies of the unveiling, provided the work is all done without expense to the Academy.

Resolved, That PROF. J. A. ALLEN be added to the Audubon Monument Committee.

PROF. EGELSTON further explained the work of the committee, and the co-operation of Trinity Church Corporation in providing a new plot and vault for the remains.

PROF. EGLESTON exhibited a yellow sapphire (oriental topaz) of unusual beauty.

January 25th, 1892.

STATED MEETING.

Vice-President DR. HUBBARD in the chair. Eighteen persons present.

The minutes of January 18th were read and approved.

A letter was read from DR. JOHN C. JAY, Jr., thanking the Academy for the Resolutions adopted in memory of his father, the late DR. JOHN C. JAY.

DR. BOLTON announced that an illustrated lecture would be delivered before the Brooklyn Institute of Arts and Sciences by PROF. CHARLES V. RILEY, Chief of the Division of Entomology, U. S. Department of Agriculture, on Tuesday, March 2d, 1892.

Insects and Flowers; or, the Interrelations of Insects and Plants.

Members of the Academy were invited to attend.

The following paper was then read, entitled

The Origin and History of Mineralogical Names.

BY ALBERT H. CHESTER,

with an exhibition of classical works on Mineralogy.

(Abstract.)

The study of mineral names is an interesting one, not only from the mineralogist's point of view, as affording an insight into the growth and development of this branch of science, but also to the student of human nature, for many traits of character are shown in the various considerations which have determined the particular name to be adopted.

We sometimes find as a reason for a name the simple idea of distinguishing the thing itself; but this is not the most common reason. To do honor to some person who may perhaps be pleased or flattered by the attention, or to immortalize some place, often otherwise obscure or unknown, is a much more common reason.

Names have been given to commemorate battle-fields, to sneer at the work of earlier investigators, and as a tribute to feminine loveliness. In short the whole round of human passions has been gone over in the manufacture of these words, which are purely scientific in their uses, and for the making of which scientific methods might well have been employed. The subject has also no little interest from the philological side, and these names deserve study if only as part of language. I need make no excuse for occupying your thoughts for a short time in the consideration of this general subject.

One of the most noticeable things about mineral names is the lack of uniformity in their terminations. While the large majority of them end in—ite, there are many in—ine, while ane, ase, ose, and several others have been often used. It is to be regretted that the termination ite has not been universally adopted, for it has been so far adopted as to be the generally accepted one for such names. It has the sanction of antiquity, for it was used by the old Greek writers in the forms—ites, or—itis, as in ἁιμᾰτίτης, hematite, and ἀλαβᾰστίτις, 'alabaster.' Such forms were also used by the Romans, and we have in Pliny siderites, 'lodestone,' steatitis, soapstone, molochites, 'malachite,' and many others. These forms are undoubtedly the source of the termination ite now in use, as they are the earliest known terminations. Such names were given by the ancients as noting some property or use of the mineral, or sometimes designating its source, or the locality from which it was derived; as μαγνῆτις, a mineral from Magnesia. Or, to speak of those already mentioned, ἀιμὰτίτης is a mineral resembling blood, from the color of its powder; ἀλαβαςτίτις, a mineral from which a vessel called an alabastron was cut, siderites, from σίδηρος, iron, because it contained it, steatitis, from στέατος, 'of fat,' because it feels greasy, and molochites, from μᾰλάχη, 'mallows,' alluding to its green color.

All scientific works were written in Latin up to a very recent date, and as there was no chemistry to show differences in composition, there was no real progress in mineralogy. External characters alone were used as means of distinguishing minerals from each other, and those that looked alike must necessarily be classed together. Pliny's names were sufficient for all the uses of science down to the 16th century. There had hardly been a name added, even by Agricola, whose large works were published 1529 to 1546. The name fluor is perhaps his only new one, and that he probably did not originate, but took from the vocabulary of the furnace-men, who used it in smelting their ores. Certain minerals in general use had their common names in various languages, but there were few of these.

The use of the termination lite, in German lith, from the Greek λίθος, 'a stone,' ought here to be mentioned, as it was a genuine attempt to introduce a distinguishing mark for mineral names, and which, if successful, would have been of great benefit to mineral nomenclature, as bringing in the desirable element of uniformity. This also comes from antiquity, being found in the Greek. But it never came into general use, and in later years is hardly used at all except for euphony. There is an erroneous impression that the termination ite is derived from this, which, as we have seen, is not the case, being a much older form.

Several attempts have been made to give systematic names to minerals on some such principle as is used in other branches of natural science, but none of them have been generally adopted, and all have by degrees been dropped. One of the earliest of these was by Sir John Hill, in his History of Fossils, 1748. He divides minerals into numbered series, classes, and orders, and under these into named genera and species. His genus names are many of them new, but are sometimes older names, modified to suit his system. For instance, Marmora, for the marbles. A good example of his new names, and also of the way in which species were multiplied, when only external characteristics were considered, is in the order of inflammables. The 3d class is called Phlogoniæ, and under this we have as the 1st, Genus, Pyricubia, and under this two species—

1st. Pyricubium maximum foliaceum, and
2d. Pyricubium solidum minus.

The first of these species is simply cubical crystal of iron pyrites, striated by oscillation toward a hemi-tetrahexahedron, and the second is the unstriated crystals of the same. Octahedral pyrite is made another genus, and dodecahedral is still another. Several more genera are made from what is now the one species. This system never came into general use, and Hill himself gives it up and adopts one much more simple in his later work, 1771.

In 1820 Prof. Mohs brought out a small book entitled "The Characters of the Classes, Orders, Genera, and Species; or the Characteristic of the Natural History System of Mineralogy. Intended to enable students to discriminate minerals on principles similar to those of Botany and Geology." This system is more fully presented in his larger work of 1822–24, translated by Haidinger in 1825. He uses genus and species names for each mineral, and sometimes adds a third for more careful distinction. Under the genus garnet he gives Pyramidal Garnet, or idocrase; Dodecahedral Garnet, or true garnet, and Prismatoidal Garnet, or staurolite. Dioptase becomes Rhombohedral Emerald-Malachite.

This system was quite popular for a time, and had several imitators.

Prof. C. W. Shepard adopts Mohs's system, and in the first edition of his mineralogy, 1832–5, he not only uses his names, but extends the system still further. He, however, gives the common, or trivial name as it is called, first, and always uses them in speaking of the species. Microlite is the one new species of his own noted in this book, which under the system he calls Octahedral Tungstic-Baryte, and similar names are carried all the way through. None of these names are mentioned in his third edition, 1852–7.

In 1836, Prof. J. D. Dana read a paper before the New York Lyceum of Natural History, entitled "A New Mineral Nomenclature," in which he presents a complete arrangement according to the Natural History method, and gives some very good reasons for its adoption. This system is carried out in full in the first edition, 1837, of his great work on Mineralogy. He uses in general two names for each mineral, as Andalusius prismaticus for andalusite, but he gives the common name first in all cases. In his second edition, 1844, he retains these Latin names as the scientific ones, as necessary to "a systematic idea of the science," but adds, "the shorter trivial names should, however, be retained, as more convenient for common use." In the third edition, 1850, however, Prof. Dana discards the whole system, not even retaining the names as synonyms. A system of arrangement was adopted that was understood to be temporary, while at the end of the work a chemical classification was suggested. In the later editions, this last has been perfected, and we now have an arrangement easy of reference and answering all purposes of classification, but from which all traces of the double Latinized forms of the Natural History method have disappeared. This or some similar system is now generally followed by writers on mineralogy, much to the satisfaction of those who use their works. In 1847, Glocker published his work entitled "Generum et Specierum Mineralium Synopsis." This is perhaps the most successful attempt at a systematic nomenclature that has been made. He uses in general a Latinized form of the common name for the name of each species, with some descriptive word added. For varieties, he adds a third word, as is common in other branches of natural history. For instance, under Granatus, garnet, he gives three species: 1st. Granatus nobilis, precious garnet; 2d. Granatus hyacinthinus, cinnamon garnet; and 3d. Granatus vulgaris, common garnet, and under the latter, the varieties Granatus vulgaris fuscus, niger, viridis, flavus, and albidus. The work is in Latin, thus going back to the style of the scientific books of the last century. Recently, Prof. T. Sterry Hunt has devised a new Natural System, suggested indeed as early as 1853, but as he does not give us new names for the species, a discussion of it would be out of place here. His work is, however, exceedingly interesting, and will well repay examination by those who care to go further into that side of the general subject.

In 1728 Dr. John Woodward published a work entitled "Fossils of all Kinds Digested into a Method, Suitable to their Mutual Relations and Affinity," but it is a description from external characters only, and can hardly be called a scientific treatise. The first one that really deserves such a name is by the Swedish mineralogist, Wallerius, in 1747, which is arranged on a scientific plan, and gives us the earliest systematic description of minerals. Cronstedt, another Swedish chemist, ten years later gave us a work of much greater value, as he brought in chemical relations, as far as was possible in the crude state of that science. But few new names were added, for the study was still largely from the external side, and new species could not be recognized. With the discovery of oxygen in 1776, and the real beginning of the science of chemistry, a more correct basis for the differentiation of mineral species was found. This was aided by the application of scientific crystallography, the first edition of Delisle's work appearing in 1772, and the second, in four volumes, in 1783. From this date new names were given to minerals as the result of more extended research in this branch of study, and one of the first of these probably was prehnite, given by Werner to a mineral brought from the Cape of Good Hope by Colonel Prehn, and hence named after him. I say probably, for I have been unable to fix the exact date, as there was no publication of it, but only an announcement of some sort, probably in lectures to his students. The date was perhaps 1785, certainly not later than 1786. In 1789 there is an article in the Journal de Physique, by Sage, objecting to the use of names of persons for minerals, the text for which is this name of Werner's. But the name has kept its place, and is now the accepted one for the species. Other names, given about the same time after persons, are Witherite, after Dr. Withering, who first described it, and torberite, later changed to torbernite, after Torbern Bergmann, its first analyst. This latter mineral has gone through various vicissitudes as to its name, and a list of them, as an illustration, may not be out of place here. I take them from the last edition of Dana's Mineralogy, p. 585: Mica viridis, 1772; Chalkolith, 1788; Torberite, 1793; Uranglimmer, 1800; Torbernit, 1803; Uranite, 1814; Uranphyllit, 1820; Copper Uranite (no date); Cuprouranit, 1865.

My study of the history of mineral names was begun in the interest of Murray's English Dictionary, where these names are considered as words simply, and part of the language, as found in books. The information sought with reference to each is 1st. The author of the name; 2d, date of first publication; 3d, reference to original publication; 4th, first form, if different from the form now used by English writers; 5th, derivation; 6th, reason for the name; 7th, a short description, sufficient to identify it, particularly if the name has been used for more than one species or variety.

A good example of Erinite, a name given by Haidinger, 1828, Annals of Philosophy, 2d series, vol. iv., p. 154, from Erin, because it was supposed to have been found in Ireland. It is a green, fibrous, arseniate of copper. This description is necessary and sufficient to distinguish it from Erinite of Thompson, 1836, Thompson's Mineralogy, vol. i., p. 342, derived also from Erin, for the same reason, and properly so, for it came from Ireland. But this is a reddish, clay-like mineral from the Giant's Causeway, and probably does not merit a name at all. Full information about the majority of the names is easily obtained, and is usually to be found in the last edition of Dana's Mineralogy, up to 1868, and for later names in the several appendices added since.

In this edition Prof. Dana makes an attempt at uniformity of nomenclature by changing the terminations of many of them into ite, particularly those ending in ine, only leaving those unchanged which had come into too general use in the language to be so treated. So we have galenite, alabandite, pyrohotite, and periclasite, instead of galena, alabandine, pyrohotine, and periclase. These changes have been generally adopted, and are all in the right direction.

In 1876 Prof. Shepard published a "Catalogue of Minerals found within about 75 miles of Amherst College, Mass.," in which he proposed that the names of all acknowledged mineral species, except those of the elements and a very few more, shall uniformly end in ite, and that the termination ine shall as uniformly be used for all variety names, and those whose specific character is not fully settled.

Accordingly, he gives us gypsite, serpentite, wadite, orthoclasite, spodumenite, epidotite and many similar changes, while marmolite, picrolite, nacrite, and others are made to end in ine, marmoline, picroline, nacrine. It is hardly necessary to say that these suggestions have not been generally or fully accepted.

With reference to a considerable number of names the full information wanted is not easy to obtain, and in some cases perhaps it cannot be found at all. When it is not given in Dana's Mineralogy the student may be sure that he will have to hunt to find it. This is particularly true of obsolete names, information about which must be sought in the earlier volumes of scientific journals.

The first publication of Taylor's name killinite is in 1818, in vol. xiii., p. 4, of the Transactions of the Royal Irish Academy, a fact not stated in any work on mineralogy, as far as I have examined them. There are some names also about which very erroneous ideas as to derivation prevail, and which need correction. The name chabazite was given in the form chabasie, by Bosc d'Autic, in 1780, Journal d'Histoire Naturelle, vol. ii., p. 181, and is derived from χαβάζιος, the name given to one of the stones mentioned in the Orphic poem Περίλίθον. The name as we now have it in the poem is χαλάζιός, and the mineral should therefore have been called chalazite. Kidd called attention to the blunder in 1809; Kidd's Mineralogy, vol. i., p. 249; but the original name has held its place. It is but fair to say that the form χαβάζιος was used in the current editions of the poem at the time the name was applied.

The derivation of the word datholite has often been incorrectly given. It is really a corruption of the original name datolith, given by Esmark in 1806, from δᾰτέομαι, to divide, and λίθος, alluding to the granular structure of one of its varieties. Werner added the h for no apparent reason, and the changed form was adopted by most authors until Prof. Dana unriddled the matter and gave it its correct form again. But wise writers have tried to find another derivation for it, and one author of note says it is from δάθός, which he says means turbid, because the mineral is not clear and transparent. Another wiser one says there is no such Greek word as δάθος, which is true, and that it is from the compound word δα-θάλλος, meaning very turbid, which is no more a proper derivation than the other.

The word feldspar has been changed into felspar for no better reason than that the latter form was thought the right one. It was used by Wallerius in his Mineralogy of 1747, p. 65, in the Swedish form felt-spat, meaning field-spar. It did not originate with him probably, but may have been a popular name in his time. Da Costa used it in 1757, in the German form feld-spath, and this form was current until 1794, when we find, in Kirwan's Mineralogy, vol. i.,

p. 317, the following note: "This name seems to be derived from fels, a rock, it being commonly found in granites, and not from feld, a field; and hence I write it thus, felspar." This assumption of Kirwan has been taken for fact by all English writers, and the corrupt form is in very general use.

The point most commonly lacking is the reason for adopting the name. Where it is for some characteristic of the mineral the author often takes it for granted that it is as evident to others as to himself. The name coracite, Le Conte, Amer. Jour. of Science, 2d Series, vol. iii., p. 117, is a case in point. Le Conte does not give any derivation, but it is the name of a pitch-black variety of uraninite, and is probably derived from κόραξ, a raven. A similar case is that of adinole; Beudant's Mineralogy, 1832, vol. iii., p. 126. No derivation is given, but it may easily be conjectured from the description that it is from ἀδινός, compact. But there are other cases where there is nothing suggestive in the description, and even conjecture is at fault. Such conjectures if stated as such are of value, but to give them as a fact, as has often been done, is certainly a serious blunder, if not something worse. Yet this has often been done. In one of the large dictionaries we find the name acanticone derived as follows: From "Greek ἀκή, point, ἀντί, against, and κῶνος, cone." This is a mere guess. The name was given by d'Andrada, 1800, Journal de Physique, vol. ii., p. 240, in the form akanthicone, and is derived from ἀκανθίς, a gold-finch, and κονία, powder, because the color of the powdered mineral is yellow. A similar blunder is made with the name alvite, so called after one of its localities, Alva, Norway. In the dictionary it is derived from alvus, the belly. Another instance of a mistaken popular derivation is that of coreite, an obsolete synonym of agalmatolite, from the name of the country Corea, probably because agalmatolite is from China, and Corea is close by The name was given by Delamétherie in 1795, and he derives it from χοίρειος, of a swine, because of its greasy appearance. He at first calls it koireiite, but changed it to koreiite, and then to koreite, with a k, which has since been changed to c, giving the form resembling one derived from the name Corea. But the name ought to be choireiite, commencing with ch.

Sometimes errors of the compositor have failed of correction, and the changed names have found their way into later books as real ones. One of these is glorikite; Dufrenoy's Mineralogy, 1859, vol. iii., p. 326, which is an error for glinkite. Gibsonite, in 1847 edition of the same work, vol. iii., p. 761; is probably an error for gibbsite, but this is not so clear. Galadsite, galadstite, and galad-tite are all printer's errors for galaktite.

A curious case of this sort is seen in the various forms of the word didymite. It was announced by Schaufhautt in 1843 from δίδῠμος, a twin, because it was thought to be a second silicate containing calcium carbonate as part of its composition. The form was by some blunder given as didrimite, but this was soon changed by the author himself to the correctly derived form, didymite, the original ῠ being properly changed to y. Of this word you will find in the books four different forms, only one of which deserves any place in mineralogy.

Breithaupt gave the name kupholit, from κοῦφος, light, and λίθος, to a very light variety of serpentine. He leaves out the o of the original word, probably because the word with the o had been used before, being an obsolete synonym of prehnite. This was first changed to kuphoite and then to cyphoite, which gives little idea of its original derivation and meaning.

Many more instances might be cited, but enough has been said to show how much confusion has arisen through carelessness or unwarrantable assumption, and how desirable it is that it should be disentangled as far as possible.

The first requisite for this work was to get as complete a list as possible of the names. This was compiled from many sources, as no published list containing all the names was to be found in the books. This list was then written in alphabetical order in a book with space between the names for the facts to be noted, and plenty of space in which to insert omitted names. All the books at command were then looked through in chronological order, and facts inserted in their proper places as fast as found. In this way all desired information was obtained and collated about the great majority of the names, but a number were left either entirely blank or with the space only partially filled. Then the words were taken one by one, in order as written down, and the lacking matter filled out as far as possible. In this way the work has progressed through the letter G, which accounts for the fact that most of the names cited come in the earlier part of the alphabet. But there are a number still incomplete, and it is partly in the hope of obtaining information about some of these that this preliminary paper has been prepared.

Of Ainalite and several other words I have not found the derivation. They are given by Nordenskiöld, and probably the information is to be found in his Mineralogy of Finland, but I have not been able to see a copy of it. Albertite is a name that needs a father and a first reference. Anagenite as a name for chrome ochre seems to have no authoritative beginning. Aricite, a synonym of gismondite, is in the same position. Arsenolamprite has a complete blank after it. Aspidedelite of Weibye has only the author's name after it. Barettite, Beffonite, Beudantite, as a synonym of elæolite; Bieivosite, Bischofite as a synonym of plumbogummite.

Braardite and Bromlite are also more or less lacking. Bromlite and some others can be cleared up by consulting the Annals of General Science, a journal published by Thompson in 1836 to 1838, but I have not yet found a copy of it.

These thirteen names in A and B are all that are wanting to complete the information about the six hundred names catalogued under those letters; and the other letters have about the same proportion. Any information about these names or the books mentioned will be gladly welcomed.

One other word I wish to speak of, and that is dragonite, an early synonym for rock crystal. No suggestion is to be found as to its author or derivation, and yet it is mentioned in many books. The earliest mention I have found of it is in Zappe's Mineralogisches Hand-Lexicon published in 1817, where it has the form dragomit, probably a typographical error, as everywhere else it is spelled with an *n*. Zappe says the name refers to rounded or rolled quartz crystals, where only traces of the columnar form can be detected. It is easy to conjecture that this word is from dragonis, of a dragon, and that such specimens were thought to have some relation to the fabulous monster, but without more light on the subject nothing positive can be affirmed. But having carried you back to the age of fables, I had better close, lest you think me wandering from my subject.

NOTE.—Since the above paper was presented, the name dragonite has been completely traced back to Pliny's *Draconites*, the so-called stories of the Flying Dragon.

The paper being concluded, DR. BOLTON stated that the Library Check-list in Bolton's Catalogue, to which the speaker had referred, was compiled by a clerk in the Smithsonian Institution, and his work was unfortunately rather carelessly done. He, DR. BOLTON, would not like to be held responsible for it. DR. BOLTON said he had read in Alchemy for Murray's Dictionary and contributed about four hundred words. Murray's monumental work is not free from errors in chemistry, *benzine* and *benzene* being confounded, for example.

DR. BOLTON directed the attention of PROF. CHESTER to several early dictionaries of chemistry that might be useful to him in his research, viz.: William Johnson's, London, 1652; Martin Ruland, Frankfurt, 1612; and Sommerhoff's Lexicon, Nuremberg, 1701.

He also exhibited a copy of Bruce's American Mineralogical Journal, New York, 1814, a work of great rarity. PROF. G. BROWN GOODE had stated in print that only two copies of this journal are known to exist, one in N. Y. State Library, and one in Harvard Library (Proceedings, Biol. Soc. Washington, vol. iv., 1886–88).

DR. BOLTON also exhibited a copy of the Memoirs of the Columbian Chemical Society, Philadelphia, 1813, a book of peculiar interest and but little known.

In reply PROF. CHESTER said the Library of Hamilton College also possessed a copy of Bruce's Journal, and MR. KUNZ stated he too owned a copy.

MR. KUNZ spoke of his connection with the Century Dictionary, and of a controversy on paper he had concerning the true nature of "Rhinestone," a lexicographer of eminence claiming it to be quartz, whereas it is known to be paste.

DR. BRITTON asked PROF. CHESTER whether any definite date could be assigned to the beginnings of mineralogical nomenclature; botanical terminology dates chiefly from Linnaeus. PROF. CHESTER replied that, after Pliny, perhaps Agricola was the first authority, and that in Agricola's work he had found only one new name, *fluor*. Minerals began to be scientifically differentiated about 1780–1790, and systematic nomenclature of minerals probably dated back to this epoch.

After some remarks by DR. HUBBARD the meeting adjourned.

February 1st, 1892.

REGULAR BUSINESS MEETING.

Vice-President DR. HUBBARD in the chair. Eighteen persons present.

The minutes of January 4th were read and approved.

PROF. THOMAS EGLESTON reported, on behalf of the Audubon Monument Committee, that $9004 had been subscribed, of which about $250 would probably never be paid. He then introduced the following resolutions, which were adopted :—

Resolved, That the Audubon Monument Committee have power to erect the monument to Audubon, and to make the proper arrangements for the ceremonies of the unveiling, provided the work is all done without expense to the Academy.

Resolved, That PROF. J. A. ALLEN be added to the Audubon Monument Committee.

PROF. EGLESTON further explained the work of the committee, and the co-operation of Trinity Church Corporation in providing a new plot and vault for the remains.

PROF. EGLESTON exhibited a yellow sapphire (oriental topaz) of unusual beauty.

The Secretary presented the report of the Council, recommending candidates for election, viz:—

DR. ISRAEL C. PIERSON.
DR. J. WOODBRIDGE DAVIS.

These gentlemen were then elected by ballot.

The Secretary then read the list of officers for 1892–93, nominated by the Council, as follows:—

For Honorary President—JOHN S. NEWBERRY.
For President—OLIVER P. HUBBARD.
For 1st Vice-President—J. A. ALLEN.
For 2d Vice-President—H. CARRINGTON BOLTON.
For Corresponding Secretary—THOMAS L. CASEY.
For Recording Secretary—H. T. VULTÉ.
For Treasurer—HENRY DUDLEY.
For Librarian—JAMES F. KEMP.
For Councillors—N. L. BRITTON, CHARLES F. COX, D. S. MARTIN, H. F. OSBORN, J. K. REES, W. P. TROWBRIDGE.
For Curators—GEO. F. KUNZ, HAROLD JACOBY, ARTHUR HOLLICK, H. H. RUSBY, F. G. WIECHMANN.
For Finance Committee—JOHN H. HINTON, H. G. MARQUAND, O. B. POTTER.

On motion of DR. BOLTON the Committee appointed June 1st, 1891, to draw up resolutions in memory of PROF. C. A. JOY, a former President of the Academy, was enlarged by the appointment of MR. HENRY DUDLEY and DR. ALEXIS A. JULIEN. The Committee now consists of PROF. D. S. MARTIN, MR. DUDLEY, and DR. JULIEN.

The Secretary announced a donation from Captain THOMAS L. CASEY of $232, he having paid bills for publishing certain numbers of the Annals amounting to this sum.

The Treasurer requested permission to transfer $662 from the balance on hand to the Publication Fund, this amount being made up of sundry fellowship and initiation fees, and Captain CASEY's two gifts: granted

PROF. JAMES F. KEMP read a paper on

The Elaeolite Syenite near Beemerville, Sussex Co., N. J.

BY J. F. KEMP, COLUMBIA COLLEGE.

The elaeolite syenite exposure near Beemerville, N. J., is of great interest, not alone because it is a rare and unique type of rock, but also because it is quite remote from any other igneous outbreak which is commensurate with it. Throughout the whole adjacent region only sedimentary and metamorphic rocks occur, with the exception of a few subordinate basic dikes.

Elaeolite syenites are not abundant the world over, and are only known in a few places on this continent. The other American exposures are at Montreal, Canada; Litchfield, Maine; Salem and Marblehead, Massachusetts; and the region about Magnet Cove, Arkansas. The hornblende syenites described by Hawes from New Hampshire have also been lately shown to contain elaeolite by W. S. Bayley. (Geol. Soc. of America, Columbus meeting, 1891.)

Basic dike rocks of a kind usually found in association with elaeolite syenites have been recently studied by the writer on Lake Champlain, and it would be quite natural if an exposure should be found in the neighboring Adirondacks.[1]

Rocks with elaeolite or nepheline were announced years ago by Hunt[2] from Montreal, and Rosenbusch speaks familiarly of the syenite in his second edition, evidently from specimens.[3] Mr. Lacroix[4] has also published a short preliminary note, and a subsequent fuller account which appeared in 1891.[5] The syenites at Montreal were intruded after the close of the Lower Silurian and before the Lower Helderberg. The elaeolite syenite at Litchfield, Maine, has received as yet but limited petrographic study, and the most that has been written concerns its mineralogy. C. T. Jackson,[6] J. D. Whitney,[7] W. Gibbs,[8] and F. W. Clarke[9] have written of them. The last-named considers the sodalite as derived from elaeolite. Elaeolite syenite in boulders at Salem, Massachusetts, has been briefly noted

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[1] J. F. Kemp and V. F. Marsters, Trap Dikes of the Lake Champlain Valley, etc. Annals, N. Y. Acad. of Sci., 1891.

[2] T. S. Hunt, Geol. Surv. Canada, 1883, p. 665.

[3] Massige Gesteine, p. 90.

[4] A. Lacroix, Comptes Rendus, June 2, 1890, p. 1152.

[5] Syenite-nephelinique de Montreal, Bull. Soc. Geol. de France, 1889–90, p. 323.

[6] C. T. Jackson, Cancrinite, Nepheline, Zircon, from Litchfield, Me., Proc. Geol. Soc., 1845, Am. Jour. Sci., ii, i, 119.

[7] J. D. Whitney, Poggendorf's Annalen, lxx, 431.

[8] W. Gibbs, Poggendorf's Annalen, lxxi, 559.

[9] F. W. Clarke, The Minerals of Litchfield, Me., A. J. S., iii, xxxi, 262. W. S. Bayley's paper, read at the Columbus meeting G. S. A., Christmas, 1891, will appear too late for comparison in this contribution.

by J. P. Kimball,[1] and a zircon syenite (so-called) is mentioned by Wadsworth from Marblehead, Massachusetts.[2]

The Arkansas areas have long been known as a prolific source of many rare and interesting minerals, and in connection with these and in the old geological reports of the State some mention of the rocks is made; but only the recent report of the late Dr. J. Francis Williams treats the matter with thoroughness. Although usually colored as Archaean on the geological maps in the past, they are now known to be late Cretaceous.

The Beemerville area was first noted by E. Haeusser, an assistant on the New Jersey survey under Dr. Kitchell, and from his notes a brief description is taken for the New Jersey Report for 1868, p. 144. The notes are valuable as announcing the existence of the great dike, but subsequent investigation has shown that the chief minerals (hypersthene and labradorite) mentioned by Haeusser are entirely lacking. The true nature of the rock was thus overlooked by him. The remarks, however, were fruitful in bringing it to the attention of Prof. B. K. Emerson,[3] who visited it in 1881 and recognized the true character of the portion traversed by him. Prof. Emerson seems, however, to have touched the dike at only one or two points at the northern end; and as it extends nearly three miles in a northeast and southwest direction, much the greater part has remained to be subjected to the microscope.

Several outcrops of a curious basic rock occur east of the syenite, which were mentioned in the New Jersey Report for 1882, p. 67. These were subsequently more fully investigated by myself[4] and called porphyrite. Investigations and papers which have since appeared have much enlarged our knowledge of the basic rocks associated with elaeolite syenites in other localities, and the true relations of these so-called porphyrites are with the extreme basic non-feldspathic end of the lamprophyre division.

Rosenbusch has created the name monchiquite as applied to those with much olivine from Brazil, and J. Francis Williams has called others from Arkansas, with no olivine but with prevailing augite, fourchite; and I have named still another variety from Arkansas, with great amounts of biotite, ouachitite. The Beemerville basic rocks are ouachitite.

The elaeolite-syenite dike lies on the southeastern slope of the Kittatinny Mountain ridge, and some eight miles west of Deckertown, the nearest railway station. Deckertown is situated at the crossing of the New York, Susquehanna and Western, by the Penn-

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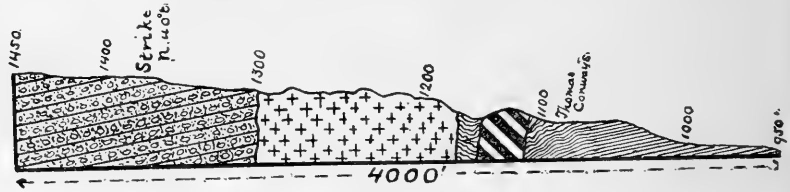
[1] J. P. Kimball, On Sodalite and Elaeolite from Salem, Mass., A. J. S., ii, xxix, 65, quotes G. L. Streeter, in Proc. Essex Inst., ii, 153.

[2] Zircon syenite from Marblehead, Mass., Proc. B. S. N. H., xxi, 406, 1880–82.

[3] B. K. Emerson, On a Great Dike of Foyaite or Elaeolite Syenite in Northwestern New Jersey, A. J. S., iii, xxiii, 302. A full quotation of Haeusser's notes is made in the paper.

[4] J. F. Kemp, On Certain Porphyrite Bosses in Northwestern New Jersey, A. J. S., iii, xxxviii, 130.

sylvania, Poughkeepsie and Boston, and is eight miles south of the New York State line. The dike is two miles from the small town of Beemerville, which is the nearest place of any importance. It is fourteen miles northwest of Franklin Furnace, where the famous zinc mines are located. The general valley of the Walkill River extends from Deckertown westward, and is chiefly formed of Hudson River shales or slate, which, according to Mr. Darton's later investigations, should be called in part Trenton.[1] Under these, east of Deckertown, is a blue limestone, and overlying them unconformably on the west is the Kittatinny conglomerate, which forms the ridge of that name and corresponds to the Oneida conglomerate of New York. The dike comes out along the contact of the conglomerate and the slate. They have been spoken of as unconformable in the New Jersey Report for 1868, but this is a mistake.



SECTION XX

The ridge, as shown on the map (which is an enlarged portion of the New Jersey topographical map sheet No. 1), forms a steep hillside some six hundred feet above the neighboring valley. No stream of any size runs down its sides across the syenite, and only small gulches afford exposures. The dike forms a great terrace, and is, in its broadest part, 300–400 yards across. Its outcrop is marked by a lineal succession of conical hillocks, with small gullies between, making rough topography. A depression runs along the western edge of the dike, and is somewhat wet. This marshy land effectually conceals the western contact. On the north the dike runs out as an easterly spur on the ridge. Evidences of its baking action on the shales run further, but no eruptive rock appears. It terminates with a steep hillside covered by loose fragments. At the southern extremity the eruptive rock appears along the Brick House Road, which crosses the mountain, but beyond the road it cannot extend far, as a great precipitous cliff of conglomerate called Decker's Rocks comes in and diagonally cuts off its course. No outcrops appear at the foot of the cliff, and the float material is all baked shale and sandstone.

The dike varies considerably along its course. The typical elaeolite-syenite forms the northern third and the southern extremity, but between these points its character changes. Near the northern

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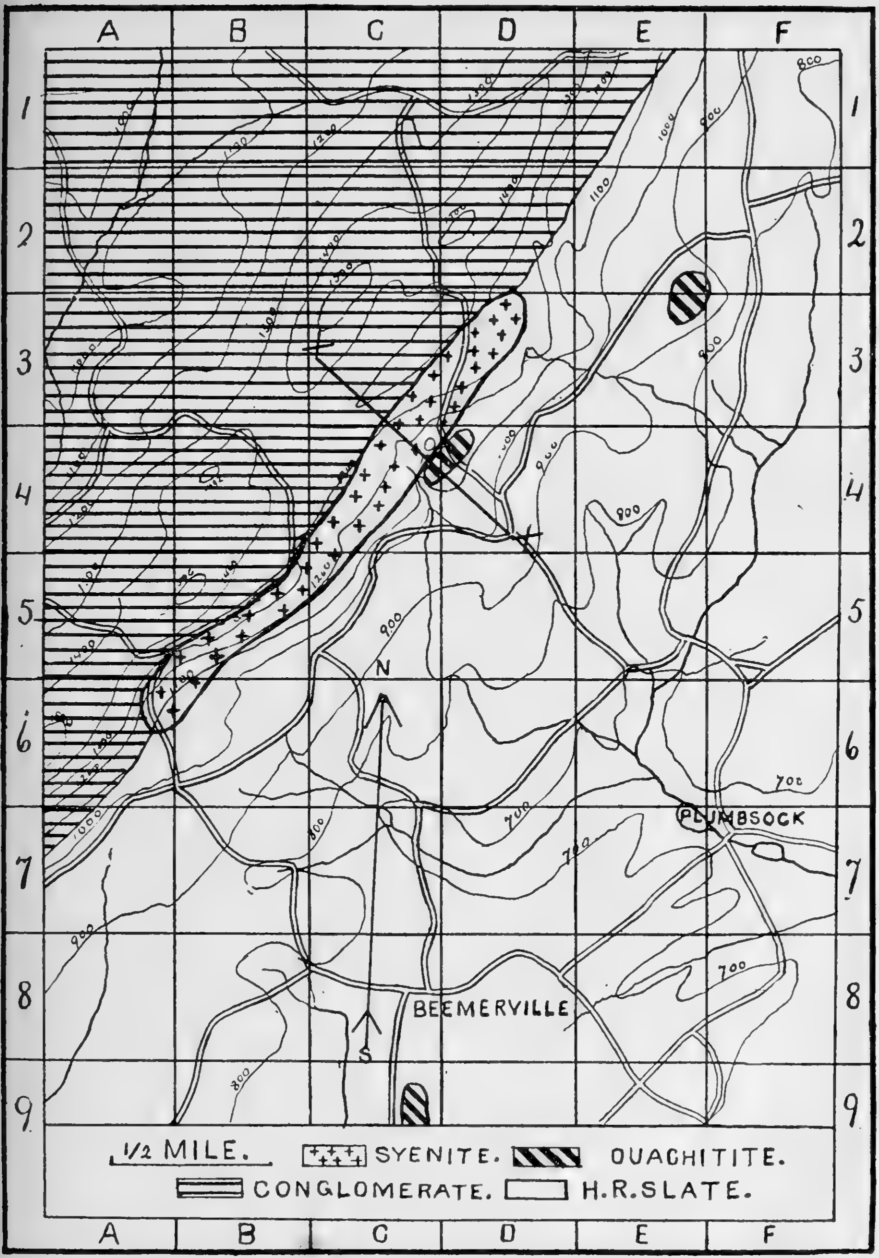
[1] N. H. Darton. A. J. S., iii, xxx, 452, and xxxi, 209.


A
B
C
D
E
F
1
2
3
4
5
6
7
8
9
N
S
PLUMBSOCK
BEEMERVILLE
1300
1200
1100
1000
900
800
700
1/2 MILE.
SYENITE.
OUACHITITE.
CONGLOMERATE.
H.R.SLATE.

part of the middle third elaeolite porphyry appears, and forms a most beautiful example of this rock. It may come from dikes, as no actual exposures are available. Further south a basic holocrystalline rock comes in which is exposed in place; and, as subsequently shown, contains less silica and more biotite than the typical syenite. But on the extreme south where the highway crosses the dike, the rock is much like that on the north. It is, however, greatly decomposed, and fresh, firm pieces are hard to find. The basic lamprophyric rocks outcrop on the east, at the several points shown on the map, and extend to a distance of several miles with isolated outcrops.

The typical characteristic elaeolite-syenite of the north is the rock described by Emerson, and little remains to be added to his diagnosis. It outcrops as small hillocks in the woods, which are covered with great boulders, loosened by disintegration. The commonest rock consists of large pinkish orthoclase crystals, which may, in the coarsest variety, be two inches long, and are twinned on the Carlsbad law. In the interstices of these the elaeolite and aegirine are chiefly found, and far less often they occur in the slide as inclusions in the feldspar. The orthoclase also appears as small rod-shaped, once-twinned crystals associated with the elaeolite. The elaeolite is allotriomorphic in irregular masses. Emerson notes in addition a rare and earlier generation of smaller idiomorphic crystals. The elaeolite is largely changed to cancrinite, which appears in mosaics of irregular individuals, and is the only alteration product which I have detected. No zeolites appear. The cancrinite seems to have been overlooked by Emerson. Sodalite is not infrequent, and forms, at times, an inclusion of hexagonal outline in the orthoclase. Aegirine is associated with the elaeolite and forms small prismatic crystals. In the slides they are a fraction of a millimeter in diameter and several times as long. They are seldom, if ever, terminated, but have irregular ends. The pleochroism is strong, being two closely similar shades of grass-green along the axes of elasticity, which nearly correspond with axial c and b ($= \mathfrak{a}$ and $\mathfrak{b}$ of Rosenbusch, or $\mathfrak{c}$ and $\mathfrak{b}$ of Descloizeaux respectively), and brownish-yellow on axial a ($= \mathfrak{c}$ of Rosenbusch and $\mathfrak{a}$ of Descloizeaux). An optic axis shows plainly in sections near 0P (001), and affords a negative figure with the quarter undulation plate. Several large crystals were picked out of a decomposing syenite, and the prism angle was measured on a Fuess No. II. goniometer. The faces were not very good, and necessitated the employment of the Websky delta ocular. Three of the best readings were 87° 14′, 87° 12′, 87° 33′, corresponding closely with the 87° usually given for aegirine, and with the 87° 13′ (92° 87′) given by Emerson. The orthopinacoid is also present. A specimen was found in which the aegirine prisms reached a length of an inch or more, and had a marked parallel arrangement with elongated orthoclase crystals, like a very coarse flow structure. The same thing has been remarked by Brögger in Norwegian exposures and referred to this cause rather than to pressure. A deep reddish-brown biotite is also occasionally present, but is far more abundant toward the south of this upper third of the dike. Its colors are those of the biotite commonly seen in nepheline rocks, but it has a well-marked divergence of the optic axes. It affords an excellent percussion (schlag) figure, and the plane of the optic axis is parallel to the principal ray (010), proving it a mica of the second order, as is to be expected. It occurs in irregular shreds, and is older than the aegirine. The most micaceous normal syenite is a short distance south of Thomas Conway's house. Titanite is usually present, and from decomposed syenite small crystals (0.5 mm.) can be picked out which show good faces. They are honey-yellow in color. Professor Rosenbusch, to whom I have sent a suite of specimens and with whom I have had some correspondence, remarks the passage of the titanite into bordering rutile nets. He also has noted the occasional presence of fluorite, which has escaped my notice. Small amounts of magnetite are generally seen, and pyrite is common.

A partial analysis (I.) of number 34, which was collected as nearly as I could determine from the point visited by Professor Emerson, was kindly made by Mr. F. W. Love, of Cornell University. The complete results were not obtained in time to insert, but will be distributed in the reprints. Column II is the ditroite of Hungary (Fellner, Verh. d. k. k. Geol. Reichsanstalt, 1867, 286, quoted by Rosenbusch, Tsch. Mitth., xi, 144, Taf. 1). Column III is the elaeolite-syenite of Brazil (Machado, Tsch. Mitth., ix, 334). Column IV. is the elaeolite-syenite of Arkansas (J. F. Williams, Igneous Rocks of Ark., p. 81). Column V is the Norwegian elaeolite-syenite (Brögger, Syenitpegmatitgänge, p. 33).

	I.	II.	III.	IV.	V.
Loss	3.512	1.6	3.60	1.88	0.22
SiO_2	50.36	56.3	52.75	59.70	51.90
Al_2O_3	19.34	24.1	22.55	18.85	22.54
Fe_2O_3	6.94	2.0	3.65	4.85	4.03
FeO	—	—	—	—	3.15
CaO	3.43	0.7	1.85	1.34	3.11
MgO	—	0.1	0.15	0.68	1.97
K_2O	—	6.8	7.05	5.97	4.72
Na_2O	—	9.3	8.10	6.29	8.18
		100.9	99.70	99.56	99.82

It thus appears that the Beemerville rock is rather basic in its chemical composition. Several pounds of the rock were crushed fine and panned for small minerals of high specific gravity, but only aegirine, titanite, magnetite, and a little apatite resulted. Emerson found a variety that was nearly pure elaeolite, and much the same has been met by me along the contact just above Thomas Conway's house. The rock is very finely crystalline and contains wavy lines of aegirine and biotite, due to flow structure. The biotite, at times, resembles a secondary filling of a crack, as the plates lie across the long direction of the flow lines. A short distance from the contact, however, the dike becomes the coarsely crystalline syenite and extra rich elaeolitic portions could only be extremely local.

I searched carefully and in many places for endialyte or eucolite, but none appeared. Professor Rosenbusch notes small crystals of a questionable mineral in a slide of a finely crystalline variety sent him, as perhaps one of these. One or the other may be discovered in the future. In the writer's opinion it would not be worth while to make separate varieties of the rocks with aegirine and of those with biotite, as there is hardly a pure specimen of either. Experience in this occurrence thus corroborates the general conclusions laid down by Rosenbusch about the subdivisions of the elaeolite-syenites. Small hornblende crystals regarded as arfvedsonite are noted by Emerson, but they have escaped my attention if present in my slides.

At the middle point of 4 C on the map the character of the dike changes, as is indicated by the float fragments, for no actual exposures occur. Porphyritic facies appear, and an excellent elaeolite-porphyry was found. By an odd coincidence the same kind of rock was discovered at almost the same time by the late Dr. J. Francis Williams, with whom the writer was in active correspondence, in Saline Co., Arkansas, making the first American records of this rare rock species simultaneous in two widely separated regions (see Igneous Rocks of Ark., p. 149). The Beemerville porphyry is dark greenish in color, and has great hexagonal phenocrysts of elaeolite up to an inch in cross section. The slides show a ground mass perfectly typical of the dikes recently called tinguaite by Rosenbusch, from the Brazilian occurrences. They furnish a structure among the elaeolite dike rocks closely analogous to the phonolites of the effusives, and the dikes were indeed called phonolites by Derby, their original discoverer.[1] The ground mass consists essentially of elaeolite surcharged with microscopic aegirine needles. Orthoclase is present and many crystals of a very peculiar pyroxene. This is light yellow in color, with a pleochroic change along axial *b* to a pinkish shade. It is idiomorphic, and has an extinction that may reach 44°. Professor Rosenbusch estimates the angle of the optic axes at about 55°. An optic axis emerges not greatly inclined to the basal section.

Closely associated with the pyroxene is a reddish-brown nearly isotropic mineral, of high index, that is much like perofskite. A few shreds of biotite are also seen.

Another porphyritic rock occurs along this portion of the dike, which lacks the large phenocrysts of elaeolite. It has, however, others of feldspar, and in the slide shows the same tinguaitic base

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[1] O. A. Derby, On Nepheline Rocks in Brazil with Special Reference to the Association of Phonolite and Foyaite, Q. J. G. S., August, 1887.

with a much more prismatic development of the elaeolite in the ground mass.

An analysis yielded the results in column I. Column II is of the elaeolite porphyry from Magnet Cove (J. F. Williams, Igneous Rocks of Arkansas, p. 261).

	I.	II.
Loss	1.14	2.06
SiO_2	45.18	44.50
TiO_2	—	1.40
Al_2O_3	23.31	22.96
Fe_2O_3 FeO	6.11	6.84
CaO	4.62	8.65
MgO	1.45	1.65
K_2O	5.945	4.83
Na_2O	11.165	6.70
	98.92	99.59

The rock is thus more basic than the syenite, and illustrates a change to a more basic composition as the south end of the dike is approached. It is very basic also when considered as an analogue of phonolite, and is nearer the theralites. With some variations it has other close points of correspondence with the analysis quoted by its side.

The sections of the New Jersey phonolitic or tinguaitic specimens have been compared with a set which were made from a suite of the corresponding Brazilian varieties which are in the rock collections of Columbia College. They were presented some years ago by Mr. Derby. The resemblance is most striking and indeed so close that the slides might readily be confounded. The New Jersey examples show no tendency to cleave in thin plates like ordinary phonolites and like some of the Brazilian examples, but break in angular fragments; hence the name elaeolite-porphyry seemed appropriate and was employed above. The correlation of many types in the two exposures is remarkable.

Still further south, at a point half-way between the last and the southern extremity of the dike, a prospect hole has been blasted by some one in the top of a conical hillock. It has opened up a cavity some few feet deep, and brought out a quantity of perfectly fresh material. The rock is rather finely crystalline, dark in color, and very tough. It looks like a fine mica diorite, and has a great proportion of dark silicates. The sections exhibit elaeolite, orthoclase, aegirine, biotite, titanite, many minute zircons and apatites. Except the minute inclusions, all the components are allotriomorphic. The aegirine and biotite especially appear in shreds and small irregular masses. No cancrinite is present, and from this fact, as the rock is perfectly fresh, the conclusion is unavoidable that the cancrinite to the north is secondary and derived from the elaeolite. Careful search was made for plagioclase in the slides, yet none appears. The following analysis shows how basic the rock is, and that the silica is remarkably low for one with orthoclase:—

	Loss.	SiO_2.	Al_2O_3.	Fe O. Fe_2O_3.	CaO.	MgO.	K_2O.	Na_2O.	Total.
Specimen 30 . .	0.45	41.37	16.25	16.93	12.35	4.57	3.98	4.18	100.08
Magnet Cove . .	5.20	38.93	15.41	9.34	16.49	5.57	1.78	5.27	

In the last analysis (J. F. Williams, Igneous Rocks of Arkansas, p. 226), there is additional TiO_2 1.62, FeS_2 0.89, P_2O_5 0.35, and traces of several other elements, making a total of 100.57. The specimen had evidently suffered alteration, but shows some close analogies with the first analysis. It is an elaeolite mica syenite, the Cove type of Williams. The locality of specimen 30 is near the northeast corner of 5 B of map.

Still further south, at the extreme end of the dike, syenite occurs like that at the north. Along the highway it has crumbled away to sand, as was noted by Haeusser, and only by searching can fresh material be found. The slides show it to be like the syenite of the northern end, and cancrinite again appears. The porphyritic type is also to be had in float material.

We may say of the dike in general that it is normal elaeolite-syenite at its extremes, but that it becomes more basic toward the southern portion. It may consist of several different outflows along the same line. It uniformly contains aegirine and more especially in the contact and southern parts has biotite. It is penetrated in places by subordinate dikes of elaeolite porphyry. The analyses bring out forcibly the extraordinary range in composition which elaeolite-syenite may take, running down into the extreme basic end of the series of rocks. The same thing is shown in Arkansas, to an even greater degree, by J. F. Williams. This is only rendered possible by the intermingling of orthoclase with such basic minerals as nepheline and sodalite and by relatively abundant bisilicates. The rock has been consistently called elaeolite-syenite throughout the text, because it was studied in close association with J. F. Williams, by whom the name was preferred for the Arkansas exposures and is used in work already published. With the decadence of the time element in petrographic classification, there is no good reason (nor, indeed, ever was) for preserving the names elaeolite and nepheline for the same mineral, and it would be far better to use the latter term, which is recognized by the mineralogists. As is done by the French, the whole group might better be called nepheline-syenite.

It is unfortunate that the Beemerville exposure is situated in a region where no streams of any size cross it—where no railroads or artificial cuts in all probability will ever open it up—and that it is quite densely covered with woods over almost its entire extent. The conditions are unfavorable for good exposures.

The Associated Basic Rocks.—As already remarked, it is a curious fact that peculiar basic dikes are almost universally associated with elaeolite-syenite. This is true of the localities in the Monchique Mountains of Portugal, of the Norwegian exposures, of those in Brazil, at Montreal, Magnet Cove, Salem (as recently discovered by J. E. Wolff), and Beemerville, and it is possible that they may yet be found in the other American localities. The dikes lying outside the syenite areas in Arkansas have been recently described by the writer, and in the paper which has just appeared in the annual report of the Arkansas State Survey for 1890, vol. ii, p. 392, a review is given of those elsewhere. Along the eastern side of the Beemerville syenite a number of such outbreaks are found. Their determination as porphyrite in the American Journal of Science for 1888 has since been revised. Although the available material is much decomposed, they were shown to consist of large biotite phenocrysts with somewhat smaller and less abundant augite, in a groundmass mostly changed to calcite, but which was thought to have had close affinities with nepheline. Some plagioclase also appeared as a constituent of the groundmass. The rocks are dense and black and belong in the Lamprophyre division. In the Arkansas examples much fresher material was afforded, and this, too, from about 75 or 100 dikes. There is almost no definite nepheline, but the minerals are in a glass of no great abundance. It is probable that this was the original condition of these basic dikes at Beemerville. The Arkansas dikes, rich in biotite (and in instances this forms half the rock), were named ouachitite, from the Ouachita River, along which they occur. Macroscopically, the ouachitite is indistinguishable from the alnoite of Törnebohm (cited from the original Swedish by Rosenbusch, Mass. Gest., p. 804), the Norwegian melilite rock, but they contain no trace of melilite.

The New Jersey rocks are mostly ouachitite, with some fourchite, and the names are accepted from the later developed locality on account of the fresher material.

There is some underlying genetic connection between the elaeolite-syenite and these other basic rocks, but what it is I feel at a loss to say. Rosenbusch thinks them due to a splitting of his foyaite magma. Other dikes occur at a distance of ten or fifteen miles; a number are shown in the map, A. J. S., Aug. 1889, p. 131. The one called mica-diabase by Emerson, from Franklin Furnace, has long been known, and others of the same sort have recently been determined by G. H. Williams for F. L. Nason, in the last annual Report of the New Jersey Survey. Rosenbusch, however, says in a recent letter to me, regarding some specimens sent him of the Franklin Furnace dike, that there is nothing of the true ophitic structure of diabase in them, but that they are a lamprophyre of unusual type, and near the camptonites. My own observations would substantiate this view.

I have also a curious dike from Hamburg, north of Franklin Furnace, that is not yet mentioned in print and that is closely related to the theralites. It cuts blue limestone and has some curious spherulites like the kugel minettes of the Germans. Mr. Derby, however, at once remarked their likeness to altered leucite crystals now being studied by himself and Hussak in Brazil. I am not prepared to speak authoritatively on them as yet.

The dike is doubtless connected with the syenite eruption. It contains a reddish biotite, the same yellow pyroxene mentioned in the elaeolite porphyry, aegirine, titanite, feldspar, analcite secondary from nepheline, and nepheline. It is satisfactorily fresh.

Emerson mentions a crystalline mass of calcite, biotite, and magnetite, from a point above D. B. Roloson's, which he regards as the result of contact metamorphism. I have been to the same locality, and have found the ouachitite further up the hill. So far as I know, limestone is unknown in the shale of the vicinity, and I regard the specimen in question as a thoroughly altered ouachitite.

Contact Metamorphism.—The intrusion of this great body of rock has naturally exerted a powerful influence on the neighboring shales. Haeusser and Emerson remark this effect at the distance of a mile to the east, and the same was noted by myself.

Emerson describes a specimen from the north as resembling a claystone porphyry. In a felsitic groundmass are opaque Carlsbad twins of orthoclase, six to eight millimeters across, with chlorite, small rhombs of calcite and cubes of pyrite. The groundmass with high powers was resolved into fine scales of muscovite. Some incipient crystallizations suggested chiastolite crystals by the collection of colored hydrocarbons.

My slides show a great development of biotite in the hornstone of the contact, and this gives the dark color to the rock. The leaves in the densest specimens are of extreme minuteness, sinking to 0.001 of a millimeter. In others they are coarser. They lie parallel and suggest the foliation of a mica schist; but they give no evidence of this to the macroscopic examination. Quartz is also present and probably feldspathic matter.

Along the Brick House Road, on the extreme south, one of the best opportunities is afforded for the study of the contact effects The baked flinty shales outcrop in the road in places and appear to be seamed by narrow apophysae from the main dike.

Slides of other shales gathered from points apparently near the dike show only a clastic mass of very fine grain, and as soon as a distance of 200 to 300 yards is reached, or even less, unless a ouachitite dike has been intruded, there seems to be no noticeable mineralogical change, although the greater density and hardness are very apparent.

The ouachitites come out as eruptive breccia in part, and are not to be confused with contact influences. Some slides of very fine slate from near the contact with them show no mineralogical change, and in general the metamorphism seems rather physical than mineralogical.

The contact influence on the Kittatinny sandstone and conglomerate is not discernible. The clastic character remains unaltered, although to ordinary observation the rocks seem harder. A ledge was found that could not have been more than 15 yards from the syenite, but the slide shows no appreciable mineralogical change. The sandstone is, however, rendered so crystalline at times, that it is difficult to detect its clastic character without a thin section.

Connection between present topography and crystalline structure.—Professor W. M. Davis has been giving much attention of late to the topographic development of this region,[1] and the approximate geological dates of many of the upheavals and drainage systems have been pointed out. The conclusions have a certain bearing on the age of the syenite. The great dike exhibits over its outcrop a coarsely crystalline structure except in the case of the porphyry, which is probably a subordinate narrow intrusion. The orthoclase crystals even reach very large size, and the granitoid character of the rock indicates that it crystallized at a considerable depth, and was in no sense a surface flow. The outcrop stands now at the level of what Davis calls the Schooley peneplain, which marks the base-level of a post-Triassic system of drainage. The dike must have suffered the erosion of this time, and perhaps of earlier cycles in order to expose its coarsely crystalline portions, and it is reasonable to place its intrusion at an earlier period. But as regards its age we are only able to say, that it is later than the Oneida conglomerate at the beginning of the Upper Silurian, and before the Triassic or late Triassic. During this long interval, there occurred the Carboniferous subsidence and post-Permian upheaval, and the dike may have been a concomitant occurrence with one of these.

GEOLOGICAL LABORATORY, COLUMBIA COLLEGE.

At the close of the paper many specimens illustrating the subject were exhibited, and the discussion was carried on by PROF. BRITTON and others.

The Secretary announced that the 50th Anniversary of the Hungarian Society of Natural Sciences would be commemorated on January 17, 1892.

Also that members of the Academy were invited to attend the meeting of the New York Section of the American Branch of the Society of Psychical Research to be held at Columbia College, February 10th, 1892.

Meeting adjourned.

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[1] W. M. Davis and J. W. Wood, Jr., Geographic Development of Northern New Jersey, Proc. Bost. Soc. Nat. Hist., vol. xxiv, 1889, 385, 411. W. M. Davis, The Geological Dates of Origin of certain Topographic Forms on the Atlantic Slope of the U. S., G. S. A., vol. ii, 559.

February 8th, 1892.

STATED MEETING.

The meeting was held in the Lecture Room of the Electrical School, Columbia College. Forty-two persons present.

In the absence of regular officers PROF. TROWBRIDGE was called to preside.

The minutes of January 25th were read and approved.

The Astronomical Section then organized. MR. JACOBY, the Secretary, stated that the President of the Section, PROF. REES, was unavoidably absent and requested PROF. TROWBRIDGE to act in his place.

DR. M. I. PUPIN read a paper on—

Vacuum Discharges and their Bearing upon the Electrical Theory of the Solar Corona,

illustrated by experiments.

At the close of the paper there was considerable discussion by MR. JACOBY, PROF. TROWBRIDGE, and others.

MR. JACOBY said that many of the phenomena observed had been photographed, and suggested that copies should be furnished to several prominent astronomers.

Meeting adjourned.

February 15th, 1892.

STATED MEETING.

Vice-President DR. HUBBARD in the chair. Two hundred and fifty persons present.

The minutes of February 8th were read and approved.

DR. HUBBARD announced to the Academy the loss sustained in the death of one of its Honorary Members, DR. T. STERRY HUNT. The following is a brief account of his life:—

Dr. Thomas Sterry Hunt, one of the leading chemists and geologists of the country, died at 5.30 P.M. yesterday, at the Park

Avenue Hotel, from mitral disease of the heart. Dr. Hunt was born in Norwich, Conn., September 5, 1826, and came of an old New England family, which had first settled in Massachusetts as far back as 1635. He was educated for the medical profession, but his love for chemistry and mineralogy led him to become a special student, and he was soon appointed an assistant to Professor Benjamin Silliman, Sr., in Yale College. In 1847 he was appointed chemist and mineralogist to the Geological Survey of Canada, which position he held until he resigned it in 1872. He made the first systematic attempt to subdivide and classify geologically the stratiform crystalline rocks; a work to which he brought not only his studies throughout Canada and the United States, but those made during repeated visits to the British Islands and continental Europe. To him science is indebted for the distinctions and the designations of Laurentian, Norian, Huronian, Montalban, Taconian and Keweenian, all of which have passed into the literature of geology. He was one of the organizers of the Laval University, at Quebec, and was professor of chemistry there from 1856 to 1862. For four years he was lecturer in McGill University, Montreal, and was professor of geology at the Massachusetts Institute of Technology from 1872 to 1878. He had the following degrees: M. A., Harvard; Sc. D., Laval; LL.D., McGill, and finally LL.D., Cambridge, England. A fellow of the Royal Society of London since 1859, he was a member of a large number of other societies, both American and foreign. He was a member of the National Academy of Sciences; had been president of the American Association for the Advancement of Science, and of the American Institute of Mining Engineers, and was twice president of the American Chemical Society. He was one of the founders, and the first president by election of the Royal Society of Canada. One of the organizers of the International Geological Congress, he was its first secretary, and was a vice-president at the congresses of Paris, 1878; Bologna, 1881, and London, 1888. Dr. Hunt was a member of the international juries at Paris in 1855 and in 1867, and at the Centennial Exhibition in 1876. He was an officer of the French Order of the Legion of Honor, and an officer of the Italian Order of St. Mauritius and St. Lazarus. In 1878 he retired from public professional life. Dr. Hunt was the author of many works, among which are "A New Basis for Chemistry," "Systematic Mineralogy," and "Chemical and Geological Essays."

DR. H. CARRINGTON BOLTON delivered the Fifth Lecture of the Public Course on—

Street Scenes in Cairo and Glimpses of the Nile,

illustrated by lantern views, partly original.

At the close of the lecture the meeting adjourned.

February 22, 1892.

ANNUAL MEETING.

Fifteen persons present.

In the absence of the regular officers, PROF. REES was chosen to preside.

The minutes of February 15th were read and approved.

The chairman called for reports of standing committees.

In the absence of the chairman, DR. BRITTON made a brief verbal report for the Audubon Monument Committee, and requested that the committee be continued. Granted.

The committee on the Joy Memorial reported progress, and requested to be continued. Granted.

PROF. BRITTON read the following paper by title:—

A List of Species of the Genera Scirpus and Rynchospora occurring in North America.

BY N. L. BRITTON.

Read Feb. 22, 1892.

SCIRPUS, L. Gen. Pl., 12 (1737).

The genus *Scirpus* was described by Linnæus in his "Genera Plantarum," p. 12 (1737), and he there attributes the name to Micheli. Linnæus described the species as known to him in 1753 in his "Species Plantarum," pp. 47–52, naming *S. articulatus*, of Java, first. This is therefore the type of the genus.

The North American species were monographed by Torrey, in his "Monograph of North American Cyperaceæ" (Ann. Lyc. Nat. Hist. N. Y., iii, 316–334 (1836)). He recognized fifteen, one of which has since been found to be an *Eleocharis*. The number now known to me is thirty-six, two of which occur only in Mexico.

Scirpus is closely related to *Eleocharis* on the one hand and *Rynchospora* on the other. I have given a list of the North American species of *Eleocharis* in the Journal of the New York Microscopical Society, v, pp. 95–111. *Scirpus* is principally distinguished from *Eleocharis* by the absence of the persistent enlarged base of the style which is so good a mark of the latter genus. In *Scirpus* the style is slender and falls away leaving the apex of the achenium merely pointed.

In this paper, as in my preceding one on *Eleocharis*, I have been greatly assisted by Mr. C. B. Clarke, of Kew, who has determined several points for me, and kindly allowed me to look over his manuscript of the genus as a whole, prepared for his forthcoming volume on the Cyperaceæ of the world. We are not altogether agreed on the limits of species, Mr. Clarke being disposed to treat some of those which I think are distinct as varieties.

* Spike solitary, or sometimes 2, sessile, terminal, or lateral.

† Spike solitary, terminal.

1. **Scirpus nanus,** Spreng.

Scirpus nanus, Spreng., Pug., i, 4 (1815).
Scirpus pusillus, Vahl, Enum., ii, 246 (1806)?
Scirpus parvulus, R. & S., Syst., ii, 124 (1817).
Scirpus capillaceus, Ell., Bot. S. C., i, 75 (1816), not Michx.
Eleocharis pygmæa, Torr., Ann. Lyc., iii, 313 (1836).
Chætocyperus membranaceus, Buckl., Proc. Acad. Nat. Sci. Phila., 1862, 10.

On salt marshes, Cape Breton Island to Florida and Texas. Apparently also in California. Saline soil, near Onondaga, N. Y. (Dudley). Sea-coast of Europe.

Var. **anachætus** (Torr.).

Eleocharis pygmæa, var. *anachæta*, Torr., Ann. Lyc., iii, 441 (1836).
Scirpus leptos, Sauv., Fl. Cub., 176 (1873).
Isolepis leptos, Steud., Cyp., 91 (1855).

Louisiana (Hale); New Orleans (Drummond, 409); Cuba (Wright); Mexico (Berlandier, 130, in part); Albuquerque, New Mexico (Bigelow).

2. **Scirpus pauciflorus,** Lightf.

Scirpus pauciflorus, Lightf., Fl. Scot., 1078 (1777).
Scirpus Bæothyron, Ehrh., Phyt., No. 31 (1780).
Eleocharis pauciflora, Link, Hort. Ber., i, 284 (1827).

In wet ground, Anticosti to western New York, western Pennsylvania, Ontario, Illinois, Minnesota, Manitoba, British Columbia, and in the Rocky Mountains south to Colorado, and to California. Also in Europe.

3. **Scirpus pumilus,** Vahl.

Scirpus pumilus, Vahl, Enum., ii, 243 (1806).
Isolepis pumila, R. & S., Syst., ii, 106 (1817).
Isolepis oligantha, C. A. Meyer, Cyp. Nov. 3, t. 1 (1830).

Rocky Mountains (Hall and Harbour, 583, in Herb. Calcutta and Boissier, fide C. B. Clarke; also in Herb. Gray); Morley, British Columbia, Rocky Mountains (Macoun, 44). Europe.

The species is distinguished from the following by its shorter spike, narrower basal bracts not nearly as much imbricated, creeping rootstocks, and less sharply triangular achenium with no bristles.

Hall and Harbour's No. 583 is mixed, for Mr. Clarke informs me that that number in Herb. De Candolle is *S. cæspitosus.*

4. **Scirpus cæspitosus,** L.

Scirpus cæspitosus, L., Sp. Pl., 48 (1753).
Eleocharis cæspitosa, Nees, Linnæa, ix, 294 (1835).

Greenland and Labrador to Alaska and British Columbia; south to the mountains of New England, and on the higher southern Alleghenies; western New York, Illinois, Michigan, Minnesota, and in the Rocky Mts. south to Colorado (Hall and Harbour, 583, in Herb. D. C., fide C. B. Clarke). A form with greatly elongated stems from Cape Breton Island (Macoun). Also in Europe and Asia.

†† Spikes 1 or 2, subtended by an involucral bract or leaf.

5. **Scirpus Clintoni,** A. Gray.

Scirpus Clintoni, A. Gray, Am. Journ. Sci. (II), xxxviii, 290 (1864).
S. planifolius, var. *brevifolius*, Torr., Ann. Lyc., iii, 442 (1836), not *S. brevifolius*, Roxb.

St. Patrick, New Brunswick (Vroom); western New York (Clinton); Lansing, Mich. (L. H. Bailey); Hubbardston, Mich. (C. F. Wheeler). Also Broad River, N. C. (Rugel, in Herb. Kew, fide Clarke).

6. **Scirpus planifolius,** Muhl.

Scirpus planifolius, Muhl., Gram., 32 (1817).
Isolepis planifolia, Spreng., Neue Ent., iii, 10 (1822).
Eleocharis planifolia, Nees, Linnæa, ix, 294 (1835).

Dry woodlands, Rhode Island to Delaware, west to western New York and Pennsylvania. Also in western Missouri (B. F. Bush, fide S. Watson).

7. **Scirpus subterminalis,** Torr.

Scirpus subterminalis, Torr., Fl. N. U. S., i, 47 (1824).

In ponds and streams, New Brunswick to the Canadian Rocky Mountains, Washington, and Oregon, south to New Jersey, Pennsylvania, and Michigan.

S. subterminalis, var. *terrestris*, Paine, Cat. Pl. Oneida Co., 96 (1865), is the emersed state of the species. Litchfield, N. Y. (Paine); Hidden Lake, Herkimer Co., N. Y. (Clinton).

8. **Scirpus cernuus,** Vahl.

Scirpus cernuus, Vahl, Enum., ii, 285 (1806).
Scirpus riparius, Spreng., Syst., i, 208 (1825).
Scirpus pygmæus, A. Gray, Proc. Amer. Acad., vii, 392 (1868).
Isolepis leptocaulis, Torr., Bot. Whipple Exp., 97 (1857).
Isolepis pygmæa, Kunth, Enum., ii, 191 (1837).
Isolepis pygmæa, var. *Californica*, Torr., Bot. Wilkes Exp., 476 (1874).

In wet places, British Columbia, Oregon, and California. Also in South America and in Europe and Australia.

9. **Scirpus carinatus** (H. & A.).

Isolepis carinatus, H. & A., in Torr. Ann. Lyc., iii, 349 (1836).
Scirpus carinatus, A. Gray, Proc. Am. Acad., vii, 392 (1868).
Isolepis koilolepis, Steud., Cyp., 318 (1855).

In low grounds, Alabama, Mississippi, Louisiana, Texas, Arkansas, and the Indian Territory to California.

** Spikes several or numerous, capitate or umbelled, subtended by 1 or several involucral leaves.

10. **Scirpus Cubensis,** Poepp. & Kunth.

Scirpus Cubensis, Poepp. & Kunth, in Kunth, Enum., ii, 172 (1837).
Scirpus ablepharus, Griseb., Cat. Pl. Cub., 240 (1866).
Oxycaryum Schomburghkianum, Nees in Mart. Fl. Bras., ii, Pars. I, 90 (1842).
Anosporum Cubense, Bœck., Linnæa, xxxvi, 413 (1870).

In swamps, Louisiana (Carpenter); New Orleans (Hale); near Mobile, Alabama (Mohr.). Also in the West Indies and eastern South America, and in Africa.

11. **Scirpus Mexicanus,** Clarke, ined.

Scirpus cyperoides, Hemsley, Bot. Biol. Centr. Amer., iii, 461 (1885), not Spreng. Syst., i, 208 (1825).
Cyperus ——, S. Wats., Proc. Amer. Acad., xviii, 169.

Mexico: San Luis Potosi (Schaffner. 566; Parry and Palmer, 905); Flor de Maria, Mexico (Pringle, 3173).

12. **Scirpus Potosinus,** Clarke, ined.

Moist banks of ravines, San Jose Pass, San Luis Potosi, Mex. (Pringle, 3175, Coll. 1890, distributed as "*Cyperus*, near *C. elegans*, Vahl.")

13. **Scirpus Hallii,** A. Gray.

Scirpus Hallii, A. Gray, Addenda, Man. Ed. 2 (1863).
S. supinus, var. *Hallii*, A. Gray, Man. Ed. 5, 563 (1867).

Massachusetts: Winchester (W. Boott; Hitchings; Morong). Illinois: Menard Co. (E. Hall). Florida: Indian River (Curtiss, 3118*). Missouri: St. Louis (Engelmann). Texas: (Wright; Lindheimer. Colorado: (Greene). Mexico: Vera Cruz (Müller, 2153); San Luis Potosi (Schaffner, 571; 201).

14. **Scirpus debilis,** Pursh.

Scirpus debilis, Pursh, Fl. Am. Sept., i, 55 (1814)

Maine: Harrison (Blake). New Hampshire: Plymouth (Morong); west to Minnesota, Lake Minnetonka (Seymour); south to Georgia, Alabama, and Nebraska.

Small forms of this species run close to the next, but the presence of bristles in *S. debilis*, equalling or longer than the nut, is here taken as distinctive.

15. **Scirpus Smithii,** A. Gray.

Scirpus Smithii, A. Gray, Man. Ed. 5, 563 (1867).

Pennsylvania: shores of the lower Delaware (C. E. Smith); Presque Isle, Lake Erie (Garber). New Jersey: Camden (Parker); Little Timber Creek (A. H. Smith); Budd's Lake (Porter). New York: Watertown and Sackett's Harbor (Gray); Luzerne (Clinton); Sodus Bay (Paine). Massachusetts: Williamstown (Torrey). Rhode Island: Kingston (Morong). Vermont: Ferrisburgh (C. E. Faxon). Michigan: Pine Lake, near Agricultural College (Wheeler). Minnesota: Hennepin Co. (Sandberg).

16. **Scirpus mucronatus,** L.

Scirpus mucronatus, L. Sp. Pl., 50 (1753).

In a swamp in Delaware Co., Pa. (C. E. Smith); the only known American locality.

17. **Scirpus Americanus,** Pers.

Scirpus Americanus, Pers., Syn., i, 68 (1805).
Scirpus triqueter, Michx., Fl. Bor. Am., i, 47 (1803), not L.
Scirpus pungens, Vahl, Enum., ii, 255 (1806).
Scirpus mucronatus, Pursh, Fl. Am. Sept., i, 55 (1814), not L.

In salt or fresh marshes and low grounds throughout North America. Also in Chili.

Var. **longispicatus,** n. var.

Spikes 2–4, 1–2 cm. long, pale; bristles longer than those of the type, and achenium more broadly obovate.

New Mexico: (Wright, 1963). Colorado: Platte River, near Denver (Dr. Geo. Smith).

18. **Scirpus Nevadensis,** S. Wats.

Scirpus Nevadensis, S. Wats., Bot. King's Exp., 360 (1871).

Nevada: Soda Lake (Watson, 1213); Hawthorn (Jones, 4088). California: borders of Mono Lake (Brewer, 1846). Oregon: Harney Valley (Howell). Western British America: Rocky Mountains (Bourgeau); Cypress Hills, Old Wives' Lakes, and Great Plains (Macoun). British Columbia (Fletcher). Also in South America: Catamarca (Grisebach); Atacama (Philippi).

19. **Scirpus Olneyi,** A. Gray.

Scirpus Olneyi, A. Gray, Bost. Journ. Nat. Hist., v, 238 (1845).

In salt marshes, Rhode Island to Florida, Texas, Arizona, Mexico, extending to Arkansas (Coville), and along the Pacific coast to Oregon. Also in the West Indies.

20. **Scirpus Torreyi,** Olney.

Scirpus Torreyi, Olney, Proc. Providence Franklin Soc., i, 32 (1847).

In wet places. Rhode Island: Smithfield and Providence (Olney). Massachusetts: near Boston (Hitchings—specimens young and referred here with doubt). Vermont: banks of the Winooski River (Morong). New York: West Point (Torrey); Buffalo (Clinton). Pennsylvania: near Warrior's Mark, Huntingdon Co. (Lowrie); Round Lake, Carbon Co., and 12 mile pond, Pike Co. (Porter). Minnesota: Hennepin Co. (Sandberg). Kansas: Manhattan (Kellerman)? Manitoba: Lake of the Isles, N. W. Terr. (Houghton, 14).

21. **Scirpus cylindricus** (Torr.).

Scirpus maritimus, var. *cylindricus*, Torr., Ann. Lyc. N. Y., iii, 325 (1836).
Scirpus macranthus, Bœckl., Flora, 1858, 415.
Scirpus leptolepis, Chapm., Fl. S. U. S., 520 (1860).
Scirpus Canbyi, A. Gray, Am. Journ. Sci. (III), xxxviii, 289 (1864).
Rhynchospora etuberculata, Steud., Cyp., 142 (1855).

Maryland: Salisbury (Canby, Commons). North Carolina (Dr. Loomis, G. McCarthy). Georgia: Columbus (Dr. Boykin). Florida (Chapman). Louisiana (Hale). Alabama: Mobile (Sullivant).

22. **Scirpus lacustris,** L.

Scirpus lacustris, L. Sp. Pl., 48 (1753).
Scirpus validus, Vahl, Enum , ii, 268 (1806).
Scirpus acutus, Muhl., Gram., 33 (1817).
Scirpus orgyralis, Raf., Ann. Nat., 16 (1820).

In ponds and streams throughout North America. Also in Mexico and the West Indies, and widely distributed in the Old World.

Var. **occidentalis,** S. Wats.

S. lacustris, var. *occidentalis*, S. Wats., Bot. Cal., ii, 218 (1880).

California (Bolander, 6231): Sacramento Valley (Wilkes Exp.); Kern Co. (Greene). Nevada (Torrey, 555); Mouth of Reese River (Watson, 1212). New Mexico (Wright, 1940; Wheeler Exp., 104). Arizona: Santa Cruz River (Pringle). British Columbia (Macoun).

23. **Scirpus Californicus** (C. A. Meyer).

Elytrospermum Californicum, C. A. Meyer, Mem. Acad. Petersb. (V), i, 200, t. 2, 1830.
Scirpus riparius, Presl., Rel. Hænk., i, 193 (1830), not Spreng.
Scirpus Tatora, Kunth, Enum., ii, 166 (1837).

In swamps. Florida (Chapman); Louisiana (Hale); New Mexico (Wright, 1939). Found also by Rev. Dr. Wibbe, at Oswego, N. Y.; widely distributed in southern and central California, Mexico, Central, and South America.

24. **Scirpus maritimus,** L.

Scirpus maritimus, L. Sp. Pl., 51 (1753).

In swamps. Manitoba to Nebraska, Texas, and Mexico; west to the Pacific Coast. Also in Europe, Asia, Africa, and Australia.

The plant of the northwest coast, as illustrated by the specimens from Puget Sound (Wilkes's Exp.), Umpqua River (Howell), and Vancouver Island (Macoun), appears to be identical with the European, but I have seen no ripe fruit of it. Many of those from the interior of the continent, such as Watson's 1214, from Humboldt Sink, Nevada; Wright's 1962 and 1942, from New Mexico; and others ranging from Nebraska to Sonora, differ in having very light-colored glumes, and have a compressed nut, much like that of the following species. These may form a distinct species. The European specimens which I have examined have a trigonous nut.

25. **Scirpus robustus,** Pursh.

Scirpus robustus, Pursh, Fl. Am. Sept., i, 56 (1816).
S. maritimus, var. *macrostachyus*, Michx., Fl. Bor. Am., i, 32 (1803).
Scirpus macrostachyus, Muhl., Gram., 45 (1817), not Lam.
Scirpus maritimus, Torr., Ann. Lyc. N. Y., iii, 332, and other American authors, not L.

Salt marshes. Nova Scotia (?), New England to Florida, Mississippi, and Texas.

26. **Scirpus fluviatilis** (Torr.).

S. maritimus, var. *fluviatilis*. Torr., Ann. Lyc. N. Y., iii, 324 (1836).
Scirpus fluviatilis, A. Gray, Man. Ed., i, 527 (1848).

In swamps. Quebec and Vermont, through Ontario to Minnesota; south to Connecticut, southern Pennsylvania, Illinois, and Missouri. (Banks of the Missouri, above St. Louis, Dr. Baldwin, July 6, 1819.)

27. **Scirpus criniger,** A. Gray.

Scirpus criniger, A. Gray, Proc. Amer. Acad., vii, 392 (1867).

California: Humboldt Co. (Bolander); Mendocino Co. (Kellogg); Plumas Co. (Mrs. Austin); Modoc Co. (Miss Plummer); Wood's Peak, near Amador Pass (Brewer, 2115). Oregon: Curry Co. (T. Howell).

28. **Scirpus rufus** (Huds.).

Schœnus rufus, Huds. Fl. Angl., 15 (1778).
Scirpus rufus, Schrad., Fl. Germ., i, 133 (1806).

In several localities in Quebec and New Brunswick (see Macoun, Cat. Can. Pl., Part iv, 101). Also in brackish marshes, Red Deer River, Northwest Territory (Macoun).

* * * Spikes very numerous in terminal, large, compound umbels.

29. **Scirpus sylvaticus,** L.

Scirpus sylvaticus, L. Sp. Pl., 51 (1753).
Scirpus brunneus, Torr., Ann. Lyc., iii, 326 (1836), not Muhl.?

In swamps. Massachusetts (Cooley); northern New Jersey (Austin, Apgar, Best, Britton); New York; Pennsylvania: Tobyhanna, Pocono Mts., and banks of Octorara Creek, Lancaster Co. (Porter); Monroe, Bucks Co. (J. A. Ruth); Gap, and near Smithville, Lancaster Co. (Small). Delaware: Centreville (Commons). West Virginia: White Sulphur Springs (Britton). North Carolina: near Hickory, Catawba Co. (Heller and Small, 274).

30. **Scirpus microcarpus,** Presl.

Scirpus microcarpus, Presl., Rel. Hænk., i, 195 (1830).
Scirpus lenticularis, Torr., Ann. Lyc. N. Y., iii, 328 (1836).
S. sylvaticus, var. *digynus*, Bœckl., Linnæa, xxxvi, 727 (1870).

In swamps. Nova Scotia and Quebec, through British America to Alaska; south to New Hampshire: near base of Mt. Washington (Morong); New York: Buffalo (Clinton); banks of the Mohawk, near Schenectady (Wibbe); Lyon's Falls, Black River (Haberer). Minnesota; Nevada: Reno (Tracy, 230, F.); and rather common in California and Oregon.

31. **Scirpus atrovirens,** Muhl.

Scirpus atrovirens, Muhl., Gram., 43 (1817).
S. sylvaticus, var. *atrovirens*, Bœckl., Linnæa, xxxvi, 495 (1870).

In swamps. Nova Scotia to Manitoba; south to Georgia and Louisiana.

Var. **pallidus,** Britton.

S. atrovirens, var. *pallidus*, Britton, Trans. N. Y. Acad. Sci., ix, 13 (1889).

Nebraska: Little Blue River, S. Platte (H. Engelmann); Hitchcock Co., and Broken Bone, Custer Co. (Webber). Minnesota: Hennepin Co. (Sandberg). Kansas: Mitchell Co. (M. A. Carleton). Indian Territory (Palmer, 358). Colorado: Cañon City (Brandegee). Oregon: Multomah Co. (T. Howell); Medicine Hat, Saskatchewan River (J. M. Macoun).

32. **Scirpus divaricatus,** Ell.

Scirpus divaricatus, Ell., Bot. S. C., i, 88, t. 2, f. 4 (1816).
Scirpus lineatus, Muhl., Gram., 45 (1817), fide Torrey, not Michx.
Scirpus ambiguus, Schult., Mant., ii, 85 (1824).

In swamps. Florida and South Carolina to Louisiana; Kentucky (Short in Herb. Kew, fide Clarke).

33. **Scirpus polyphyllus,** Vahl.

Scirpus polyphyllus, Vahl, Enum., ii, 274 (1806).
Scirpus exaltatus, Pursh, Fl. Am. Sept., i, 56 (1814).
Scirpus brunneus, Muhl., Gram., 43 (1817).
S. brunneus, vars. *crispus* and *viviparus*, Torr., Ann. Lyc. N. Y., iii, 327 (1836).

In swamps. Massachusetts to North Carolina and Alabama; west to Minnesota and Arkansas.

34. **Scirpus Peckii,** n. sp.

S. polyphyllus, var. *macrostachys*, Bœckl., Linnæa, xxxvi, 731 (1870), ex descrip. not *S. macrostachyus*, Lam.

Tall, slender, 0.6–1.2 m. high, stem leafy. Leaves elongated linear, long-acuminate, 2–4 dm. long, 6–10 mm. wide, those of the involucre 3–5, the largest of them exceeding the inflorescence; umbel several rayed, the rays slender, 1–6 cm. long; spikes 4–8 mm. long, cylindric, capitate in clusters of 2–10, appearing umbellulate in age by the falling away of the lower scales; scales dark brown, ovate, carinate, mucronate; nut trigonous, 0.5 mm. long, oblong, acute at each end, twice as long as thick, slender-beaked; style 3-cleft; bristles 4–6, downwardly barbed more than one-half their length.

New York: Lake Pleasant, Hamilton Co. (C. H. Peck); near Schenectady (Wibbe); West Albany (P. A. Puissant). Connecticut: Middletown (Barrett). Also an old specimen in Herb. Torrey, with no definite locality.

Nearest to *S. radicans*, Schk., of continental Europe. That species differs, however, in its umbellulate, ovate, shorter spikelets, broader and less mucronate scales, and longer, twisted, smooth bristles. I take pleasure in associating with this interesting plant the name of the distinguished State Botanist of New York, who has done so much in making known the flora of our Commonwealth.

35. **Scirpus cyperinus** (L.).

Eriophorum cyperinum, L. Sp. Pl., Ed. 2, 77 (1762).
Trichophorum cyperinum, Pers., Syn., i, 69 (1805).
Scirpus cyperinus, Kunth, Enum., ii, 170 (1837).
Scirpus Eriophorum, var. *cyperinus*, A. Gray, Man. Ed. 2, 501 (1856).

In swamps. Newfoundland to western Ontario, south to New Jersey and Pennsylvania. This may very well occur further south, but I have not seen specimens from the Southern States. Also in India.

Var. **Eriophorum** (Michx.).

Scirpus Eriophorum, Michx., Fl. Bor. Am., i, 33 (1803).
Scirpus thyrsiflorus, Willd., Enum., 78 (1809).
Scirpus Eriophorum, var. *laxus*, A. Gray, Man. Ed. 2, 501 (1856).
Eriophorum cyperinum, var. *laxum*, Wats. and Coult. in A. Gray, Man. Ed. 6, 582 (1890).

In swamps. New Brunswick to western Ontario, south to Florida and Louisiana.

36. **Scirpus lineatus,** Michx.

Scirpus lineatus, Michx., Fl. Bor. Am., i, 32 (1803).
Trichophorum lineatum, Pers., Syn., i, 69 (1805).
Scirpus pendulus, Muhl., Gram., 44 (1817).
Isolepis lineata, R. and S., Syst., ii, 117 (1817).
Scirpus brizoides, Willd. ex Link, Jahrb., iii, 89 (1820).
Eriophorum lineatum, Benth. and Hook., Gen. Pl., iii, 1052 (1883).
Scirpus Drummondii, Steud., Cyp., 318 (1855).

In swamps. Southern Ontario to Georgia, west to Minnesota, Kansas, and Texas. Also in Oregon: Waldo and Grant's Pass (T. Howell).

RYNCHOSPORA, Vahl, Enum., ii, 229 (1806).

Dr. Gray's revision of the North American species of *Rynchospora* and *Ceratoschœnus*, published in Ann. N. Y. Lyc. Nat. Hist., iii, 363–372, included in Dr. Torrey's Monograph of the N. A. Cyperaceæ, supplementary to his monograph printed in earlier pages of the same volume, recognized 29 species. Drs. Torrey and Gray always regarded the genus *Psilocarya* as valid, and 3 species were recognized in the monograph above mentioned, making in all 32 species of the three genera. In the following enumeration all are regarded as belonging to *Rynchospora*, in this following the views of Mr. C. B. Clarke, who has favored me, in his usual kind manner, with an abstract of his arrangement of the North American species, on which the present paper is based. The relation of *Dichromena*, Michx., to the group is exceedingly close, and its species have been included in *Rynchospora* by O. Bœckeler, but I follow Mr. Clarke in keeping it up.

Of the 60 species here recognized 16 are Mexican, West Indian, and South American, only so far as is now known, there being thus 44 species in the United States and Canada.

I have followed Vahl's original spelling of the generic name, which has by subsequent authors usually been written *Rhynchospora*.

I. Subgenus **HAPLOSTYLIS,** Benth.

Style entire or only shortly bifid, never cleft to the middle.

* Culm monocephalous.

1. **Rynchospora Mexicana** (Liebm.).

Haplostylis Mexicana, Liebm., Mex. Halvg., 61 (1849).
Rynchospora Mexicana, Steud., Cyp., 144 (1855).

Oaxaca, Mex. (Liebmann); near Guadalahaja, Mex. (Pringle, 2628).

2. **Rynchospora globosa,** R. and S.

Rynchospora globosa, R. and S., Syst., ii, 89 (1817).

Mexico (Liebmann). [Cuba, Wright, 3403.]

* * Culm normally polycephalous.

3. **Rynchospora cyperoides** (Sw.).

Schœnus cyperoides, Sw. Prodr. Fl. Ind. Occ., 19 (1788).
Rynchospora cyperoides, Mart., Denksch. Akad. Wiss. Munch., 1816–1817, 149.
Ephippiorhynchum polycephalum, Nees.

Mexico (Liebmann). [Cuba, Wright, 3404; St. Domingo, Eggers, 1696. Porto Rico, Blauner, 253; South America.]

4. **Rynchospora Tracyi.**

Ceratoschœnus capitatus, Chapm., Fl. S. U. S., 529 (1860), not *R. capitata*, R. & S.

Florida (Chapman; Garber; Keeler; Curtiss, 3143); Ocean Springs, Miss., a monocephalous form (Tracy, No. 60).

* * * Inflorescence paniculate.

5. **Rynchospora corymbosa** (L.).

Scirpus corymbosus, L. Sp. Pl., 76 (1753).
Rynchospora aurea, Vahl, Enum., ii, 229 (1806).

Mexico; Nicaragua; Guatemala (Tuerckheim, 1257). [West Indies, South America, and in tropical regions of the Old World.]

6. **Rynchospora corniculata** (Lam.).

Schœnus corniculatus, Lam., Ill., i, 137 (1791).
Schœnus longirostris, Michx., Fl. Bor. Amer., i, 35 (1803).
Rynchospora longirostris, Ell., Sketch Bot. S. C. and Ga., i, 35 (1816).
Rynchospora laxa, Vahl, Enum., ii, 231 (1806), not of R. Br.
Rynchospora corniculata, A. Gray, Ann. Lyc. N. Y., iii, 205 (1835).

Southern Pennsylvania and Ohio to Florida, west to Missouri and Louisiana and Texas.

Var. **macrostachya** (Torr.).

Ceratoschœnus macrostachyus, Torr., Ann. Lyc. N. Y., iii, 369 (1836).
Rynchospora macrostachya, Torr. in A. Gray, loc. cit., 206 (1835).

Eastern Massachusetts and Rhode Island to Florida, west to Arkansas, the Indian Territory (Palmer, 357), and Texas (Hall, 721).

Var. **patula** (Chapm.).

Ceratoschœnus macrostachyus, var. *patulus*, Chapm., Fl. S. States, 529 (1860).

Florida.

W. Boott, in Bot. Gaz., ix, 94, indicates that the characters of the bristles are not sufficient to separate these as species; this is also Mr. Clarke's opinion. Northern specimens with long bristles have quite the habit of southern ones with short bristles.

7. **Rynchospora scutellata,** Griseb.

Rynchospora scutellata, Griseb., Cat. Pl. Cub., 246 (1866); Britton, Bull. Torr. Bot. Club, xviii, 369.

Near Indianola, Texas (Ravenel). [Cuba, Wright, 3406.]

8. **Rynchospora Orizabensis,** Clarke, n. sp. ined.

Orizava, Mex. (Bourgeau, 2977; Botteri; Muller, 1958); Guatemala (Tuerckheim, 1256).

9. **Rynchospora corymbifera,** Nees.

Rynchospora corymbifera, Nees, Nov. Act. Nat. Cur., xviii, Suppl. i, 107 (1841).

Orizava, Mex. (Mohr and Botteri). Named by Mr. Clarke.

10. **Rynchospora Schiediana,** Kunth.

Rynchospora Schiediana, Kunth, Enum., ii, 300 (1837).

Mexico (Schiede; Galeotti, 5790; Linden, 68; Bourgeau, 3191; Botteri, 780; Muller, 1959).

Var. **varica,** Clarke, ined.

San Luis Potosi (Pringle, 3434).

11. **Rynchospora polyphylla,** Vahl.

Rynchospora polyphylla, Vahl, Enum., ii, 230 (1806).

Mexico (Liebmann). [West Indies; South America.]

12. **Rynchospora Tuerckheimii,** Clarke, n. sp., ined.

Guatemala (Tuerckheim, 1258).

II. Subgenus EURYNCHOSPORA, Clarke.

Style deeply bifid.

* Bristles 0, or rudimentary (*Psilocarya*, Torr.)

† Spikelets with 3-several nutlets.

13. **Rynchospora scirpoides** (Torr.).

Psilocarya scirpoides, Torr., Ann. Lyc., iii, 360 (1836).
Rynchospora scirpoides, A. Gray, Man. Ed. 5, 568 (1867).

Eastern Massachusetts and Rhode Island.

14. **Rynchospora nitens** (Vahl).

Scirpus nitens, Vahl, Enum., ii, 272 (1836).
Psilocarya rhynchosporoides, Torr., Ann. Lyc. N. Y., iii, 361 (1836).
Psilocarya Texensis, Torr. and Hook., Ann. Lyc., loc. cit. (1836).
Psilocarya nitens, Wood, Bot. and Flor., 364 (1870).
Rynchospora nitens, A. Gray, Man. Ed. 5, 568 (1867).

Wading River, Long Island (E. S. Miller); Delaware (Canby) to Florida and Texas.

15. **Rynchospora corymbiformis** (Benth.).

Scirpus corymbiferus, Sauv., Fl. Cub., 176 (1873), not *R. corymbifera*, Ness.
Psilocarya corymbifera, Benth., in Benth. and Hook. Gen. Plant., iii, 1048 (1883).
Psilocarya corymbiformis, Benth. in Hook. Ic. Plant., xv, 25, t. 1431 (1883).
Rynchospora ignorata, Bœckl., Engler's Bot. Jahrb., v, 508 (1884).

Columbus, Ga. (Boykin); East Florida (Leavenworth); Louisiana (Hale). [Cuba, Wright, 3774.]

16. **Rynchospora robusta** (Kunth).

Dichromena robusta, Kunth, Enum., ii, 283 (1837).
Psilocarya robusta, Nees in Mart. Fl. Bras., ii, Pars 1, 116 (1842).
Rynchospora robusta, Bœckl., Linnæa, xxxvii, 616 (1873).

Orizava, Mex. (Bourgeau, 2735; Muller, 1366; Botteri); Coban, Guatemala (Tuerckheim, 1261), distributed as *Rynchospora Mexicana.*

17. **Rynchospora eximia** (Nees).

Spermodon eximius, Nees, in Seemann. Bot. Herald, 222 (1852–57).
Dichromena Schiediana, Kunth, Enum., ii, 282 (1837), not *Rynchospora Schiediana*, Kunth, loc. cit., 350.
Rynchospora oxycephala, Sauv., Fl. Cub., 184 (1873).
Rynchospora eximia, Bœckl., Linnæa, xxxvii, 601 (1873).

Mexico (Liebmann); Orizava (Muller, 1964); Jalisco (Pringle, 2299). [Cuba, Wright, 3792.]

18. **Rynchospora rufa** (Nees).

Psilocarya rufa, Nees in Mart. Fl. Bras., ii, Pars 1, 117 (1842).
Psilocarya Mexicana, Liebm., Mex. Halv., 60 (1849).
Rynchospora rufa, Bœckl., Kjob. Vid. Medd., 1869–70, 149.
Rynchospora Mexicana, Sauv., Fl. Cub., 182 (1873), not Steud.

Mexico (Liebmann). [Cuba, Wright, 2683. Also in northern South America.] The original was from South America. Mr. Clarke places Liebmann's specimen as a form or variety of it.

† † Spikelets with only 1 or 2 nutlets.

19. **Rynchospora micrantha,** Vahl.

Rynchospora micrantha, Vahl, Enum., ii, 231 (1806), in part.
Psilocarya Teneriffæ, Torr. Ann. Lyc., iii, 362 (1836).

Mexico (Liebmann); Guadalahaja (Pringle, 2056); Guatemala (Bernoulli, 413). [West Indies.]

20. **Rynchospora tenuis,** Link.

Rynchospora tenuis, Link, Jahrb., iii, 76 (1820).

Mexico (Auerswald, 800; Liebmann; Muller, 124). [South America.] A widely distributed tropical American species which has received many names.

21. **Rynchospora pusilla,** Curtis.

Rynchospora pusilla, Curtis, Am. Journ. Sci. (II), vii, 409 (1849).
Rynchospora intermixta, Sauv., Fl. Cub., 184 (1873).

Florida (Chapman; Curtiss, 3170) to Texas. [Cuba.]

22. **Rynchospora divergens,** Curtis.

Rynchospora divergens, Curtis, loc. cit. (1849).
Rynchospora lamprosperma, Sauv., Fl. Cub., loc. cit. (1873).

South Carolina and Florida. [Bahamas, Eggers, 4142; Cuba, Wright, 3793; St. Domingo, Wright, Parry, and Brummel, 586; Porto Rico, Blauner, 247.]

23. **Rynchospora Chapmanii,** Curtis.

Rynchospora Chapmanii, Curtis, loc. cit. (1849).
Rynchospora heterophylla, Bœckl., Linnæa, xxxvii, 553 (1873).

Florida to Mississippi and Louisiana.

24. **Rynchospora pallida,** Curtis.

Rynchospora pallida, Curtis, Am. Journ. Sci. (II), vii, 409 (1849).
Rynchospora Curtisii, Steud., Cyp., 141 (1855).

Pine barrens, New Jersey to North Carolina.

* * Bristles plumose.

25. **Rynchospora oligantha,** A. Gray.

Rynchospora oligantha, A. Gray, Ann. Lyc., iii, 212 (1835).
R. triflora, Curtis, Bost. Journ. Nat. Hist., v, 140, not Vahl.

Lewiston, Delaware (Canby), to Florida and Texas.

26. **Rynchospora plumosa,** Ell.

Rynchospora plumosa, Ell., Sketch Bot. S. C. and Ga., i, 58 (1816).
Rynchospora penniseta, Griseb., Cat. Pl. Cub., 244 (1866).
Schœnus ciliaris, Muhl., Gram., 11 (1817), not Vahl.

South Carolina to Georgia, Florida, and Louisiana. [Cuba, Wright, 3398, Herb. Kew.]

27. **Rynchospora intermedia** (Chapm.).

R. semiplumosa, var. *intermedia*, Chapm., Fl. S. States, 524 (1860).

Florida (Chapman, Keeler, Garber, Torrey, Curtiss, 3173).

28. **Rynchospora semiplumosa,** A. Gray.

Rynchospora semiplumosa, A. Gray, Ann. Lyc., iii, 213 (1835).

Florida to Texas.

* * * Bristles retrorsely barbed.

29. **Rynchospora alba** (L.).

Schœnus albus, L. Sp. Pl., i, 65 (1753).
Rynchospora alba, Vahl, Enum., ii, 236 (1806).

Newfoundland to Alaska, south to Virginia, Florida, Pennsylvania, Minnesota, and Oregon. [Europe and Asia.]

Var. **macra,** Clarke.

Clusters larger, sometimes 3 cm. broad; bristles more numerous, 15–20.

Florida (Chapman); Texas (Drummond, 281).

30. **Rynchospora capillacea,** Torr.

Schœnus setaceus, Muhl, Gram., 6 (1817), not Berg. nor *R. setacea*, Vahl.
Rynchospora capillacea, Torr., Fl. N. and Mid. States, 41 (1826).

Vermont and Ontario to Minnesota, south to New Jersey, Pennsylvania, and Michigan.

Var. **læviseta,** E. J. Hill.

R. capillacea, var. *læviseta*, E. J. Hill, Amer. Nat., x. 370 (1876).

Lake County, Indiana.

31. **Rynchospora Knieskernii,** Carey.

Rynchospora Knieskernii, Carey, Am. Journ. Sci. (II), iv, 25 (1847).

Pine barrens, New Jersey to Virginia.

32. **Rynchospora glomerata** (L.).

Schœnus glomeratus, L. Sp. Pl., 65 (1753).
Rynchospora glomerata, Vahl, Enum., ii, 234 (1806).

New England and Ontario to Michigan, south to Florida, Mississippi, and Texas.

Var. **paniculata** (A. Gray).

Rynchospora paniculata, A. Gray, Ann. Lyc., iii, 211 (1835).
R. glomerata, var. *paniculata*, Chapm., Fl. S. States, 528 (1860).
R. glomerata, var. *robustior*, Kunth, Enum., ii, 297 (1837), ex descr.

Maryland and Virginia to Florida and Louisiana.

Var. **leptocarpa,** Chapm.

R. glomerata, var. *leptocarpa*, Chapm. MSS. in Herb. Col. Coll.

Very slender, 6–9 dm. long; clusters few, distant, simple, peduncled.

South Carolina, Florida, and Alabama.

Var. **minor,** n. var.

Low, 1.5–2.5 dm. high, slender, simple; clusters 2 or 3, with few spikelets; leaves very narrow.

Base of the White Mountains (Tuckerman); Barnstable, Mass. (Deane).

Var. **discutiens,** Clarke, MSS.

Bristles scabrous at the apex only, or glabrous throughout.

Burke Co, N. C. (Buckley); Holmead Swamp, D. C. (Coville); Chester Co., Penna. (Porter); New Jersey (Halsted).

The name *Schœnus capitellatus*, Michx., Fl. Bor. Amer., i, 36 (1803), apparently belongs to one or another of the forms of this species or the next, to which of them I am unable at present to decide. Kunth, however (Enum., ii, 297), refers it to *R. glauca*, which is unlikely.

33. **Rynchospora axillaris** (Lam.).

Schœnus axillaris, Lam., Ill., i, 137 (1791).
Rynchospora cephalantha, A. Gray, Ann. Lyc., iii, 218 (1835).
Rynchospora axillaris, Britton, Bull. Torr. Club, xv, 104 (1888).

Long Island to Florida and Louisiana.

Var. **microcephala,** n. var.

Heads smaller; spikelets only about 1 mm. wide.

Monmouth Co., N. J. (Knieskern), south to Florida and Louisiana.

* * * * Bristles scabrous upwards; achenium smooth.

34. **Rynchospora fusca** (L.).

Schœnus fuscus, L. Sp. Pl. Ed. 2, 1664 (1763).
Rynchospora fusca, Link, Handb., i, 100 (1829).

New Brunswick to Lake Superior, south to Delaware, mainly near the coast. [Europe.]

35. **Rynchospora filifolia,** Torr.

Rynchospora filifolia, Torr., Ann. Lyc., iii, 366 (1836).

North Carolina to Texas.

36. **Rynchospora fuscoides,** Clarke, n. sp.

Rynchospora filifolia, Sauv., Fl. Cub., 180 (1873), not Torrey.
R. fascicularis, var. *distans*, Chapm., Fl. S. States, 527 (1860).

Florida (Chapman); Texas (E. Hall, 717). [Cuba, Wright, 3783.]

37. **Rynchospora distans** (Michx.).

Schœnus distans, Michx., Fl. Bor. Amer., i, 36 (1803).
Rynchospora distans, Vahl, Enum., ii, 235 (1806).

South Carolina, Georgia, and Florida.

Var. **tenuis** (Baldw.).

Rynchospora distans, β, A. Gray, Ann. Lyc., iii, 216 (1835).
R. tenuis, Baldw. in A. Gray, loc. cit., as synonym.

Georgia; Florida (Curtiss, 3152 in part, fide Clarke).

38. **Rynchospora fascicularis** (Michx.).

Schœnus fascicularis, Michx., Fl. Bor. Amer., i, 37 (1803).
Rynchospora fascicularis, Vahl, Enum., ii, 234 (1806).

39. **Rynchospora brachychæta,** Sauv.

Rynchospora brachychæta, Sauv., Fl. Cub., 180 (1873).
Rynchospora gracillima, Sauv., loc. cit., 181 (1873).
R. fascicularis, var. *stenophylla*, Chapm., MSS.

North Carolina to Florida. [Cuba, Wright, 3782.]

40. **Rynchospora gracilenta,** A. Gray.

Rynchospora gracilenta, A. Gray, Ann. Lyc., iii, 216 (1835).
Rynchospora Drummondiana, Bœckl., Flora, 1858, 644.

New Jersey to Florida, Louisiana, and Texas (E. Hall, 719).

41. **Rynchospora Baldwinii,** A. Gray.

Rynchospora Baldwinii, A. Gray, Ann. Lyc., iii, 210 (1835).

North Carolina, Georgia, and Florida.

42. **Rynchospora ciliata** (Michx.).

Schœnus ciliatus, Michx., Fl. Bor. Amer., i, 36 (1803).
Rynchospora ciliata, Vahl, Enum., ii, 235 (1806).

North Carolina to Florida and Mississippi.

43. **Rynchospora Grayii,** Kunth.

Rynchospora Grayi, Kunth, Enum., ii, 539 (1837).
Rynchospora Elliottii, A. Gray, Ann. Lyc., iii, 204 (1835), not of Dietr.
Rynchospora suberostris, Bœckl., Linnæa, xxxvii, 579 (1873).

North Carolina to Florida and Texas.

44. **Rynchospora dodecandra,** Baldw.

Rynchospora dodecandra, Baldw. in A. Gray, Ann. Lyc., iii, 207 (1835).
Rynchospora megalocarpa, A. Gray, loc. cit., 208 (1835).
Rynchospora pycnocarpa, A. Gray, loc. cit. (1835).

North Carolina, Georgia, and Florida.

* * * * * Bristles scabrous upwards; achenium transversely rugose.

45. **Rynchospora glauca,** Vahl.

Rynchospora glauca, Vahl, Enum., ii, 233 (1806).
Rynchospora pungens, Liebm., Mex. Halv., 65 (1849).

Mexico (Liebmann); near Coban, Guatemala (Tuerckheim, 1260, det. Clarke). [Tropical America and Australia.]

46. **Rynchospora cymosa** (Willd.).

Schœnus cymosus, Willd., ex Muhl., Gram., 8 (1817).
Rynchospora cymosa, Nutt., Gen., i, 33 (1818).
Rynchospora Harveyana, W. Boott, Bot. Gaz., ix, 85 (1884).

New Jersey and Pennsylvania to Florida, Texas, Missouri, and the Indian Territory. [Cuba, Wright, 232.]

Kunth refers *Schœnus cymosus,* Willd., to *Scirpus polyphyllus.*

Var. **compressa** (Chapm.).

Rynchospora compressa, Chapm., Fl. S. States, 525 (1860).
R. cymosa, var. *compressa,* Clarke, MSS.

Florida and Alabama.

Var. **globularis,** Chapm.

R. cymosa, var. *globularis,* Chapm., Fl. S. U. S. 525 (1860).

Florida to Louisiana.

47. **Rynchospora punctata,** Ell.

Rynchospora punctata, Ell., Sketch Bot. S. C. and Ga., i, 60 (1816).

Georgia and Florida. The plant described by Bœckeler under this name (Linnæa, xxxvii, 580), from Mexico, is probably not the plant of Elliott, but I have not seen specimens.

48. **Rynchospora Kunthii,** Nees.

Rynchospora Kunthii, Nees, Linnæa, ix, 297 (1835), name only.

Mexico (Liebmann; E. Palmer, No. 27, 1885).

49. **Rynchospora Schaffneri,** Bœckl.

Rynchospora Schaffneri, Bœckl., Linnæa, xxxvii, 575 (1873).

San Luis Potosi, Mexico (Schaffner, 548; Parry and Palmer, 918).

50. **Rynchospora Torreyana,** A. Gray.

Rynchospora Torreyana, A. Gray, Ann. Lyc., iii, 197 (1836).

New Jersey to South Carolina.

51. **Rynchospora rariflora** (Michx.).

Schœnus rariflorus, Michx., Fl. Bor. Amer., i, 35 (1803).
Rynchospora rariflora, Ell., Sketch Bot. S. C. and Ga., i, 58 (1816).

North Carolina to Florida (Curtiss, 3171) and Texas (Hall, 716).

52. **Rynchospora microcarpa,** Baldw.

Rynchospora microcarpa, Baldw. in A. Gray, Ann. Lyc., iii, 202 (1835).

North Carolina to Florida (Curtiss, 3162 and 3149) and Texas (Hall, 710, in part). [Bahamas, Northrop; Eggers, 4308.]

53. **Rynchospora caduca,** Ell.

Rynchospora caduca, Ell., Sketch Bot. S. C. and Ga., i, 62 (1816).
Rynchospora longiseta, Steud., Cyp., 140 (1855).

North Carolina to Florida (Curtiss, 3141) and Texas (Hall, 711).

54. **Rynchospora schœnoides** (Ell.).

Scirpus schœnoides, Ell., Sketch, i, 89 (1816).
Rynchospora Elliottii, Dietr. Syn. Pl., i, 189 (1839).
Rynchospora multiflora, A. Gray, Ann. Lyc., iii, 200 (1835).

North Carolina to Florida and Louisiana.

55. **Rynchospora patula,** A. Gray.

Rynchospora patula, A. Gray, Ann. Lyc., loc. cit. 201 (1835).

North Carolina to Florida and Texas.

56. **Rynchospora decurrens,** Chapm.

Rynchospora decurrens, Chapm., Fl. S. States, 525 (1860).

Florida.

57. **Rynchospora inexpansa** (Michx.).

Schœnus inexpansus, Michx., Fl. Bor. Amer., i, 35 (1803).
Rynchospora inexpansa, Vahl, Enum., ii, 232 (1806).

Virginia to Georgia and Louisiana.

58. **Rynchospora miliacea** (Lam.).

Schœnus miliaceus, Lam., Ill., i, 137 (1791).
Schœnus sparsus, Michx., Fl. Bor. Amer., i, 35 (1803).
Rynchospora sparsa, Vahl, Enum., ii, 230 (1806).
Rynchospora miliacea, A. Gray, Ann. Lyc., iii, 198 (1835).

Florida to Louisiana. [West Indies.]

59. **Rynchospora stenophylla,** Chapm.

Rynchospora stenophylla, Chapm., Fl. S. States, 525 (1860).
Rynchospora tenuifolia, Griseb., Cat. Pl. Cub., 244 (1866).

South Carolina, Florida (Curtiss, 3174), and Alabama. [Cuba, Wright, 3393.]

60. **Rynchospora Mariscula**, Nees.

Rynchospora Mariscula, Nees, Linnæa, ix, 296 (1835), name only.
Rynchospora jubata, Liebm., Mex. Halv., 66 (1849).
Rynchospora tenuiseta, Sauv., Fl. Cub., 179 (1873).
Rynchospora odorata, Sauv., loc. cit. (1873).
Rynchospora stipitata, Chapm., Fl. S. States, Ed. 2, 660 (1884).

Florida (Chapman; Curtiss, 3174); Mexico (Liebmann). [Cuba, Wright, 3780.]

The Recording Secretary read his report for the past year, as follows:—

Report of the Recording Secretary for the year ending February 22, 1892.

There have been
8 Meetings of the Council, and
33 " " Academy, including
8 Public Lectures, and one meeting each of the Sections of Ethnology and Mineralogy, and seven meetings of the Section of Astronomy.
28 Formal or announced papers have been read on the following subjects:—

Astronomy	8	Ethnology	1
Archeology	1	Forestry	1
Botany	1	Geology	4
Chemistry	1	Mathematics	1
Electricity	3	Mineralogy	4
Engineering	1	Photography	2

Besides two papers read by title, and a number of informal communications on a variety of topics.

The average attendance, including Public Lectures, is 44, less Public Lectures 13.

There are 229 Resident Members, including 72 Fellows. During the past year the Academy has elected—

22 Resident Members.
3 " Fellows.
2 Corresponding Members.
2 Honorary Members.

9 members were lost by death, resignation, etc.

The Academy mourns the loss of a distinguished member, Dr. T. Sterry Hunt, who died recently.

H. CARRINGTON BOLTON,
Recording Secretary.

On motion the report was accepted.

The Treasurer read his report for the past year, which was accepted, and directed to be sent to the Finance Committee for audit. It is here printed in full.

The New York Academy of Sciences in account with HENRY DUDLEY, *Treasurer.*

February 25, 1891, to February 22, 1892.

RECEIPTS.

Feb. 25, 1891.	Balance		$314 38
	U. S. 4 per cent. Consols Reg. interest	$152 00	
	" " " Coupons	12 00	
			164 00
	Sale of Annals		41 00
	One-half expense of plates for article published in the Annals		100 00
	Initiation fees		70 00
	Fellowship fees		40 00
	Annual dues		1870 00
			$2599 38

DISBURSEMENTS.

Printing Annals and Transactions during 1891		$1008 95
" cards, envelopes, directory, etc.		258 25
Dr. D. S. Martin, salary as Chairman of the Publication Committee		50 00
Dr. H. T. Vulté, salary as Asst. Recd. Secty.		200 00
Expenses of Recording Secretary's office		100 00
Expressage, $5.22; insurance, $20.00; items, $5.00		30 22
Janitorial services		85 00
Travelling expenses of lecturers		35 36
Transferred to Publication Fund in M. C. S. Institution—		
Money and bills paid by Capt. T. L. Casey	$312 00	
Life membership fee	100 00	
Initiation and fellowship fees	250 00	
		662 00
Balance		169 60
		$2599 38

PROPERTY OF THE NEW YORK ACADEMY OF SCIENCES.

U. S. 4 per cent. Consols Registered	$3800 00
U. S. 4 per cent. Consols Coupons	300 00
Savings Bank Book, Publication Fund	1470 00
Savings Bank Book, General Fund	1041 77
Total invested and in Savings Bank	$6611 77

(Signed) HENRY DUDLEY, *Treasurer.*

FEBRUARY 22, 1892.

The regular order of business being finished, the chairman announced that the election of officers was in order. The Secretary read the list of nominations recommended by the Council, as follows:—

Nominations of Officers for 1892–'93.

For Honorary President—JOHN S. NEWBERRY.

For President—OLIVER P. HUBBARD.

For 1st Vice-President—J. A. ALLEN.

For 2d Vice-President—H. CARRINGTON BOLTON.

For Corresponding Secretary—THOMAS L. CASEY.

For Recording Secretary—H. T. VULTÉ.

For Treasurer—HENRY DUDLEY.

For Librarian—JAMES F. KEMP.

For Councillors—N. L. BRITTON, CHARLES F. COX, D. S. MARTIN, H. F. OSBORN, J. K. REES, W. P. TROWBRIDGE.

For Curators—GEO. F. KUNZ, HAROLD JACOBY, ARTHUR HOLLICK, H. H. RUSBY, F. G. WIECHMAN.

For Finance Committee—JOHN H. HINTON, H. G. MARQUAND, O. B. POTTER.

On motion the chair appointed Messrs. TATLOCK and FISKE tellers. The election proceeded. At the close the tellers made their report, which was read by the Secretary, accepted, and the officers declared duly elected.

PROF. REES resigned the chair to MR. DUDLEY, and addressed the meeting on the subject of increasing the Publication Fund. He favored the plan of having a suitable hall and giving a course of Public Lectures, to which a small charge should be made for admittance. To this end he introduced the following resolution:—

Resolved, That the Council be requested to consider the advisability of renting a hall and giving a course of lectures, for which a charge should be made, the profits to be placed to the credit of the Publication Fund.

Remarks *pro* and *con* were made by PROFS. BRITTON, MARTIN, BOLTON, and others, and the matter was referred to the Council for action.

DR. BOLTON called attention to the fact that the delay in issuing the TRANSACTIONS was due to remissness of authors.

MR. JACOBY favored the plan of requesting authors to submit abstracts of their papers for publication before reading them.

DR. BRITTON thought that the trouble might be corrected by sending formal notices.

DR. BOLTON replied that such a plan had been tried with little success, and that he had mentioned the cause of delay in justice to himself.

PROF. SAFFORD, the astronomer of Williams College, was introduced and made a few remarks, to the intent that he would be pleased at some future time to read a paper before the Academy.

February 29th, 1892.

STATED MEETING.

Vice-President DR. BOLTON in the chair. Twenty persons present.

The minutes of the Annual Meeting (February 22d) were read and approved.

DR. VULTÉ exhibited some crystal of metallic tin produced artificially and by accident in the following manner: Granulated tin was dissolved in hydrochloric acid, the tin being in excess, water was then cautiously added in order not to disturb the tin solution; at the junction of the two liquids a beautiful fan-shaped mass of twin crystals formed rapidly, many of the radial tufts being over one inch long. No cause has been assigned for this singular action, but it is probably due to a difference of electrical tension of the two liquids. A further study of this curious phenomenon is contemplated.

MR. ARTHUR HOLLICK read a paper on—

The Palæontology of the Cretaceous Formation on Staten Island,

illustrated by specimens, drawings, and lantern views.

If we examine any recently published geological map of this vicinity, which embraces Staten Island within its scope, we may note an area along the southern and western shores of that island colored or otherwise marked in the same manner as the adjacent shores of New Jersey. This will be found to mean that the area in question is assumed to be underlain by strata of cretaceous age, although as a matter of fact this assumption has had until recently a very slender basis in actual knowledge. Almost the entire area is covered by a mantle of either modified or bowlder drift, and the only place where the underlying strata were definitely known to be exposed was at Kreischerville, where beds of fire-clay, "kaolin," sand and gravel, similar in composition and arrangement to those at Amboy and Woodbridge, N. J., had been mined and utilized for many years. Their extent was not known, however, and no organic remains, except some fragments of lignite, had been found in them. Nevertheless, nearly every geologist who had occasion to study the region recognized what the probabilities were and concluded that the strata must be of cretaceous age and that they underlay the entire area mentioned.

On April 4, 1881, Dr. N. L. Britton read a paper before this Academy, entitled "The Geology of Richmond County, N. Y." This was published in the Annals, vol. ii, No. 6, and in it the prediction was made that cretaceous clays would be found beneath the drift to the south of the archæan ridge wherever this drift might be removed. In regard to organic remains, I quote as follows from Dr. Britton's paper: "No fossil leaves or shells have been taken from the clays of Staten Island, but it is not improbable that they will be found when the excavations are more advanced than at present." All geologists agreed practically with these views, and the failure to discover any fossil marine organisms in the clays, either on Staten Island or in the adjacent New Jersey beds, was considered as an indication that these clays had been deposited in fresh water, especially when coupled with the presence of land plant remains.

Facts have been slowly coming to light, however, and especially during the past five months important discoveries relating to the subject have been made. Most of these were recorded by me in the Proceedings of the Natural Science Association of Staten Island, and by Dr. Britton in the Transactions of this Academy, but their full importance has never been discussed.

Following is a brief review of the sequence of these discoveries, which will be of value as a prelude to the consideration of the details in connection with them:—

In June, 1883, a single cast of a large shell was found by Mr. Wm. T. Davis on the surface of a sandy cultivated field at Tottenville. It was identified by Prof. R. P. Whitfield as *Pachycardium Burlingtonense*, Whitfield. Its significance was not realized, however, and it was regarded as most likely to be an accidental estray.

In November of the same year, while in company with Dr. Britton, I found on the shore of Tottenville a few blocks or concretions of ferruginous sandstone containing imperfect impressions of vegetable remains, evidently similar to specimens previously found at Glen Cove, Long Island, and Keyport, N. J. The identity of these was at once noted by Dr. Britton and Prof. J. S. Newberry, by whom they were declared, almost with certainty, to be of cretaceous age.

In November, 1885, fossil vegetable remains, consisting of leaves, fruit, lignite, and amber, were found in one of the clay beds at Kreischerville. They were too fragmentary for determination, but were apparently identical with similar remains from the Amboy clays.

During the autumn of 1888 a piece of ferruginous sandstone containing impressions of leaves was found at Arrochar by Mr. Gilman

S. Stanton, who kindly turned the specimen over to me. This locality is at the extreme opposite end of the island to Tottenville, the only other place where fossil leaves had been found, so that, as in the case of the *Pachycardium*, the importance of the find was not realized at the time, and the opinion was expressed by me that it was probably of drift origin (Proc. Nat. Sci. Assn. S. I. Dec. 8, 1888).

Outcrops of what were apparently cretaceous clays and gravel were next discovered on the shore and in the ravine at Prince's Bay, on the shore at Eltingville, and in an excavation on the north side of the Fingerboard Road at Clifton. In the meantime the material from Tottenville was accumulating, some of the specimens being in such an excellent state of preservation that the species of leaves could be accurately studied and determined, leaving no question as to their cretaceous age. No animal remains had as yet, however, been discovered, if we except the single *Pachycardium* previously mentioned.

On May 1, 1889, in company with Dr. Britton, we were examining the clay beds along the Raritan River at Perth Amboy, N. J. Here we found ferruginous sandstones and concretions containing molluscs, but in all other respects identical with the leaf-bearing concretions from Tottenville. This encouraged us to believe that careful search on Staten Island would probably yield similar results, and such has been the case. In October of last year (1891), I found molluscs in the concretions at Tottenville, and, during the same month, specimens were also found at Arrochar. These and the ones from Perth Amboy were submitted to Prof. Whitfield, and were, by him, determined to be marine cretaceous species.

Finally, in the following month, I found well-preserved fossil leaves of undoubted cretaceous species on the shore at Prince's Bay, an intermediate locality on the south shore of the island, in concretions, in all respects similar to those from Amboy, Tottenville, and Arrochar.

Following is a list of the molluscs as far as they have been identified:—

Corbula sp? (possibly a new species), Perth Amboy.
Pachycardium Burlingtonense, Whitfield, Tottenville.
Terebratella Vanuxemi, Lyell and Forbes, Tottenville.
Terebratulina Atlantica, Say, (?) Tottenville.
Cardium (*Criocardium*) *dumosum*, Conrad, Arrochar.
Ostrea plumosa, Morton, (?) Arrochar.
Aphrodina Tippana, Conrad, (?) Arrochar.
This latter may be *Callista Delawarensis*, Gabb.
Gryphæa sp (?) (a young specimen) Arrochar.

There are also some two or three other species which are too imperfect for determination.

The plant remains are far more numerous. In some instances the stone is composed entirely of a mass of vegetable débris cemented together with limonite. In almost every one of the specimens there is some indication of plant remains, either in the form of lignite, stems, leaves, or fruit. Considerable work yet remains to be done on the material now in hand, and there is no doubt that more can be collected as soon as the weather is such as to permit of field work.

The remains comprise conifers, apparently allied to *Sequoia* and *Pinus; Thinfeldia Lesquereuxiana*, Heer; *Eucalyptus Geinitzii*, Heer; *Protæoides daphnogenoides*, Heer; *Laurus plutonia*, Heer; *Liriodendron simplex*, Newb., which latter is by far the most abundantly represented species; *Diospyros primæva*, Heer, besides many others which might be provisionally referred to other well-recognized cretaceous types. There are also some specimens which may represent undescribed species, but as nearly the entire series will doubtless be duplicated in the forthcoming flora of the Amboy clays by Dr. Newberry, and as there is no desire on my part to anticipate any of this work, it has been thought best to leave all doubtful material until some time in the future. For this reason only such specimens have been figured in the accompanying plates as are unmistakably referable to previously described cretaceous species. Nor shall I attempt to discuss whether or not these species have been placed in their proper genera by their respective authors. My object in presenting this paper in its present shape has been, first, to place all the facts upon record in a compact and available form, and second, to assist in the solution of the problem as to the extent and character of the cretaceous strata on Staten Island. With the foregoing facts in our possession it seems reasonable to consider that the existence of cretaceous strata throughout the area mentioned has been proven, and that they are of marine origin. Other points of interest, however, remain to be discussed.

The character of the rock, in which the organic remains occur, will naturally be the first to attract attention. In every instance, except in the case of the plastic clay bed at Kreischerville, the concretionary nature of the rock is apparent; the nucleus being a mass of clay or "kaolin" in which are inclosed the molluscs or plant remains, as the case may be. Limonite often forms as a crust over the outside, nodules of pyrite are frequently included, and the nucleus becomes transformed into a hard clay iron-stone, sandstone, or even chert. A large series of specimens collected show every stage in the process of formation from soft clay or "kaolin" to hard rock. In the softer material some of the carbon of the vegetation may yet be seen, but in the completely transformed material nothing except the impressions of leaves or stems remains.

Finally, the question will undoubtedly be asked, are these fossils in place where found? In order to answer this question intelligently, each locality should be considered separately. At Tottenville the fossiliferous rock has only been found on the shore at the base of a bluff, some twenty feet in height, composed almost entirely of drift material. The summit is fine sand, then bowlder clay, in which glaciated stones are abundant, and finally more or less irregularly stratified layers of sand and clay. At the shore line the base of the bluff is nearly always masked by a talus of material which has fallen from above. This is only washed away in very heavy storms or high tides, and then there may be, for a brief period, a sheer face exposed from summit to base. This was the case last autumn, and I then found the concretions in place in a hard red or buff-colored clay, immediately at the shore level, apparently an outcrop of a larger mass beneath. The clay was evidently colored by the iron from the red bowlder drift. All of these concretions were lying flat in the plane of the bedding, and were evidently formed in the strata where found. Indeed, similar concretions may be seen in process of formation there at the present time. None showed any indications of glaciation, although similar ones glaciated, but without any traces of organic remains in them, were more or less plentiful in the bowlder drift. A lenticular mass of buff and blue-colored clay was found included in the irregularly stratified material above, and in this there was more or less lignite and pyrite. This mass was apparently cretaceous material which had been scooped up, transported, and deposited intact, in the same way as it may be seen in layers and masses, inclosed in the bowlder drift overlying the "kaolin" beds at Kreischerville.

At Prince's Bay the conditions are practically the same as at Tottenville, except that the bluff is about seventy-five feet high. Clay outcrops on the shore, and is occasionally exposed by the washing away of the shingle. A heavy stone wall has been built along the shore in order to protect the light-house property from the inroads of the waters, inside which a deep talus has formed which extends far up the face of the bluff, completely hiding it from view to a distance of at least half its height. The summit is capped with bowlder drift, and beneath this, as far as can be seen, there is assorted material consisting of sandy clay, sand, and gravel, showing an unmistakable inclination towards the northwest. Much of this material is evidently pre-glacial or yellow drift, as it contains numerous silicified fossils characteristic of that formation, and the accompanying sand and sandy clay is probably cretaceous. The occurrence of this material in the bluff was first noted by Dr. Britton (Proc. Nat. Sci. Assn. S. I. Nov. 8th, 1884), who ascribed its presence there to glacial transportation *en masse.* This view is emphasized very strongly, if we consider the topography and geological structure of the island in what was the direction of glacial movement. A section in this direction (about N. 17 deg. W.*) from the Prince's Bay bluff shows a gradual slope from the top of the bluff for a distance of about seven hundred feet until it reaches tide level in a broad marsh, after which the land rises into rounded morainal hills

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* The actual direction of the glacial striæ varies somewhat at different parts of the island. The extremes thus far observed are N. 13 deg. W., and N. 20 deg. W. As no striæ are available at Prince's Bay the above is assumed as an average from the extremes noted.

until it again slopes to the waters of Staten Island Sound on the other side of the island. This section would cross directly through the clay beds at Kreischerville, and if extended would cross those at Woodbridge, N. J., so that the presence of cretaceous material, as well as pre-glacial drift, could readily be accounted for at Prince's Bay, on the theory of glacial transportation, and the same might also be said in regard to the material at Tottenville. If, however, we consider the conditions at Arrochar, we shall see that no such explanation is probable. A section across the island from this locality, in the same direction as before, soon strikes the archæan ridge, beyond which no cretaceous strata are known, so that whatever cretaceous material we may find at Arrochar must be either in place or else be derived from the immediate vicinity. Recent excavations have greatly assisted in the solution of the problem, and I was fortunate enough to arrive there one day when a fresh section was exposed. This showed at the base a layer of sandy micaceous clay containing concretions of limonite, next a layer of yellow sand and gravel, then about four feet of modified drift, and finally bowlder drift on top—a series similar in arrangement and material to those at Tottenville and Prince's Bay. In the strata of clay and overlying yellow sand I found specimens of *Cardium dumosum*, and in the gravel above were silicified corals characteristic of the pre-glacial drift. The entire series dips at an angle of about forty degrees towards the northwest.

That this stratified material has been subjected to considerable disturbance since it was originally laid down, is evident from the position in which we now find it. It is many feet vertically out of its normal position, and laterally the disturbance has been such as to transform a gradual dip of about 50 feet per mile towards the southeast into a steep dip in the opposite direction. The vertical displacement may be readily accounted for, at least in part, by the well-recognized elevation which occurred in this region since the period of glaciation. The lateral displacement, however, offers an interesting field for study. The indications are that the beds have been squeezed and distorted by the lateral pressure of the ice sheet advancing from the northwest. The exposure on the north side of the Fingerboard Road, previously mentioned, shows well-marked indications of this action. The layers of sand and clay here have been bent into a distinct monoclinal fold, with concretions lying flat in the plane of the bedding throughout the entire fold. I am also inclined to attribute the elevation of this region in part to the pressure exerted by the ice front as it advanced over the archaean ridge, and then descended with a sheer drop of some 250 feet upon the plastic cretaceous strata at the base. These were either eroded to a great depth, or else squeezed up and shoved ahead of the ice sheet. They are not indicated at the surface, and, as far as I am informed, have not been reached in any well-borings near the base of the archæan ridge; nevertheless, as we have seen, they appear at the surface, not more than two miles distant, in a southeasterly direction, at an elevation of some twenty feet above the base of the ridge and with a dip towards it.

In view of all the facts now in our possession, it seems as if the isolated and limited exposures of cretaceous strata mentioned must indicate a large and probably continuous bed of similar material throughout the entire area, as previously predicted.

As far as the exposures at Kreischerville are concerned, it was my original intention to include a description of them, with such facts as were known, in this paper; but within the past three weeks new and interesting discoveries have been made there which have rendered it advisable to postpone any detailed account of the region until these new discoveries have been more fully worked up and examined.

NOTE.—Since this paper was prepared, the United States Geological Survey has issued Bulletin No. 82, entitled "Correlation Papers—Cretaceous," by Chas. A. White. The author divides the New Jersey cretaceous strata into "marine" and "non-marine," and in the latter division places the Amboy and Staten Island clays, mostly on account of the lack of conclusive evidence to the contrary. With the facts now in our possession, however, this view seems no longer tenable, and this method of division should be abandoned.

At the close of the paper remarks were made by PROFS. BRITTON, BOLTON, and MARTIN.

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. *Pachycardium Burlingtonense*, Whitfield. Tottenville.

Fig. 2. *Aphrodina Tippana*, Conrad (?). Arrochar. (This may prove to be *Callista Delawarensis*, Gabb.)

Fig. 3. *Corbula sp?* Perth Amboy, N. J.

Fig. 4. *Ostrea plumosa*, Morton (?). Arrochar.

Fig. 5. *Cardium* (*Criocardium*) *dumosum*, Conrad. Arrochar.

Fig. 6. *Terebratella Vanuxemi*, Lyell and Forbes. Tottenville.

Fig. 7. *Gryphœa sp* (?). (A young specimen.) Arrochar.

Fig. 8. *Terebratulina Atlantica*, Morton (?). Tottenville.

PLATE II.

Fig. 1. *Eucalyptus Geinitzii*, Heer. Tottenville.

Figs. 2, 3, 4, 5, 6, 7, and 9. *Liriodendron simplex*, Newb. Tottenville and Prince's Bay.

Fig. 8. *Liriodendron primœvum*, Newb. (?) Tottenville.

PLATE III.

Figs. 1 and 2. *Protœoides daphnogenoides*, Heer. Tottenville.
Figs. 3 and 4. *Laurus plutonia*, Heer. Tottenville.
Fig. 5. *Sapindus Morisoni*, Lesq. Tottenville.
Fig. 6. *Thinfeldia Lesquereuxiana*, Heer. Prince's Bay.

PLATE IV.

Figs. 1–3. *Rhamnus Pfaffiana*, Heer. Tottenville and Prince's Bay.
Figs. 4–6. *Ficus atavina*, Heer. Tottenville.
Fig. 7. *Dalbergia hyperborea*, Heer. Tottenville.
Fig. 8. *Diospyros primæva*, Heer. Tottenville.
Fig. 9. *Platanus Newberryana*, Heer. Prince's Bay.

LIST OF LANTERN SLIDES SHOWN.

1. Clay-pit at Woodbridge, N. J.
2. Clay-pit at Burt's Creek, N. J.
3 and 4. Clay-pit at Green Ridge, Staten Island. (2 views.)
5. Clay-pit, s. s. main road, Kreischerville, Staten Island.
6. Clay-pit, near shore, Kreischerville, Staten Island.
7. Clay-pit, with overlying colored sands, n. s. main road, Kreischerville, Staten Island.
8. Stratified colored sands, overlying clay, Kreischerville, Staten Island.
9. Yellow gravel and sand, overlying clay, Kreischerville, Staten Island.
10 and 11. "Kaolin" pit, s. s. main road, Kreischerville, Staten Island. (2 views.)
12. Cretaceous material imbedded in bowlder drift overlying "kaolin" bed, Kreischerville, Staten Island.
13. Morainal plain, south of archæan ridge, Clifton, Staten Island.
14 and 15. Sections of terminal moraine, Clifton, Staten Island. (2 views.)
16. Cretaceous material, folded and overlain by drift, Clifton, Staten Island.
17. Cretaceous material, overlain by yellow gravel and drift, Arrochar, Staten Island.
18. Clay, with folded and crumpled layers, Cold Spring Harbor, Long Island.
19. Terminal moraine, Prince's Bay bluff, Staten Island. (General view.)
20 and 21. Portions of the bluff at Prince's Bay, Staten Island, showing arrangement of drift.
22. Yellow gravel and cretaceous material, imbedded in the terminal moraine, Prince's Bay bluff, Staten Island.

LIST OF SPECIMENS SHOWN.

Concretions from Perth Amboy and Keyport, N. J., containing molluscs and plant remains.

Concretions from Glen Cove, Long Island, containing plant remains.

Concretions from Tottenville, Staten Island, containing molluscs and plant remains.

Concretions from Arrochar, Staten Island, containing molluscs.

Concretions from Tottenville, showing method of formation.

Glaciated stones from the drift at Tottenville.

Silicified fossils from the pre-glacial drift at Arrochar.

Dark cretaceous clay, containing lignite and plant remains, from Kreischerville, Staten Island.

Sandy clay, containing concretions, from Arrochar.

White cretaceous clay, from Arrochar.

Sandy clay overlain by yellow sand, from a gravel pit at Clifton, Staten Island.

Cretaceous clay, containing lignite and pyrite, imbedded in bowlder drift, from Tottenville.

Cretaceous clay, imbedded in bowlder drift, from Kreischerville.

Stratified colored sands, overlying cretaceous clays, Kreischerville.

MAPS, CHARTS, ETC., USED.

Geological Map of the Vicinity of New York, by D. S. Martin, 1888.

Geological Map of Staten Island and Adjacent Territory, U. S. Geol. Survey, 1888, 1889.

Geological Map of the Clay District of Middlesex Co., N. J., Geol. Survey of N. J., 1877.

Geological map of Staten Island, with sections across the island in the direction of glaciation, by the author.

MR. HEINRICH REES made the following remarks:—

Concretions containing molluscan fossils were recently found by Dr. Britton and myself along the shore of the Raritan River just west of Perth Amboy. They had been washed out of the cretaceous clays which outcrop at that point. In the absence of Prof. Whitfield, Mr. L. P. Gratacap determined them for me as follows:—

Corbula crassiplica, Lam.

Corbula, probably a new species.

Corbula, a form intermediate between the two preceding, having the beak more centrally situated.

Cyprimeria sp.

Pectunculus sp ? This genus has not, I believe, been hitherto described from the cretaceous marls or clays of N. J.

Turritella sp ?

Mr. Gratacap stated that all the specimens were much better than many of those on which Prof. Whitfield based his descriptions in preparing his work on the Lamellibranchs of the New Jersey marls and clays.

NEW YORK ACADEMY O

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CONTENTS.

[*Continued on page* 3.

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Remarks on the Aurora of February 13, 1892.

The aurora was observed from about 6.30 to 7.15 P. M. in West 78th Street, near Riverside Drive, where an uninterrupted view was secured of the phenomenon. This aurora presented some curious and unique features, the principal of which are as follows :—

ERRATA.

On p. 129, 13th line from top, *for* "in less characteristic schists by G. H. Williams from the contacts of the Cortlandt series on the Hudson," *read* "in Europe in less characteristic schists by Teller and von John at Klausen in the Tyrolese Alps."[2]

On same page, let the footnotes read as follows :—

[1] Albany Granite and its Contact Phenomena. A. J. S., Jan. 1881.

[2] Geologisch-petrographische Beiträge etc. Jahrbuch d. k. k. geol. Reichsanst. xxxii. 589, 1882.

On p. 130, 16th line from top, *for* "0.0021, 0.0021, 0.00224, and 0.0026 per cents." *read* "0.21, 0.21, 0.224, and 0.26 per cents."

CONTENTS.

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The color of the luminous veil was a dull fiery red, such as is seen from a furnace when the flame has disappeared. Mr. Tatlock stated that in all auroras of great brilliancy which he had previously seen he had never before observed this peculiar tint.

The streamers were more nearly radial than the speaker had ever before noticed, and the peculiarity of them was that there was no undulatory motion in a direction parallel to the horizon, such as is usually seen. They presented the appearance of the light from an electric search-light directed toward the heavens, and the only variation in the display was in the degree of intensity of the light. The arch with the dark cloud beneath was particularly well defined throughout its entire length. The luminous appearance extended to a far greater degree on the western side of the pole than on the eastern. This appearance was, probably, occasioned by the fact that the moon had a high declination, and being near the horizon was then shedding its light strongly upon the eastern side of the aurora. Such portion of the veil on the eastern side as was visible appeared to be of a peculiar greenish-gray color, this appearance, undoubtedly, being caused by the position of the moon.

Mr. Tatlock also referred to the auroras of the fall of 1881 and spring of 1884, which were noted at the times they appeared for their brilliancy and extent. In connection with the aurora of this year, however, there was no band of auroral light extending from east to west and passing through the zenith, such as was visible at both of the previous auroras referred to.

At the conclusion of these remarks the meeting adjourned.

March 7th, 1892.

REGULAR BUSINESS MEETING.

The President, DR. HUBBARD, in the chair. About twenty-five persons present.

The minutes of February 4th, 1892, were read and approved.

The Astronomical Section then organized, PROF. REES in the chair. In the absence of the Secretary, MR. JACOBY, the reading of the minutes of the Section was dispensed with. PROF. REES announced the discovery of a new star in the constellation Aurigae by a Scotch astronomer; the star is between the fifth and sixth magnitudes; attention was called to it by an anonymous postal card. Its spectrum has been observed.

PROF. J. K. REES delivered a lecture on—

Ancient Astronomical Instruments.

PROF. REES explained by the aid of lantern slides the forms of instruments used by the Egyptians and Arabians, Chinese and Europeans. These included specimens of gnomons, obelisks, pyramids, sundials, graduated circles, astrolabes, quadrants, sextants, etc. Especial attention was given to the instruments employed by Tycho Brahe at his observatory at Huen.

PROF. REES called on MR. C. A. POST, who explained his plans for a portable observatory with the aid of lantern views. The wooden building cost only $250; whereas a dome of equal size would cost $2500. This observatory was built at Rockaway, N. Y.

PROF. REES asked if the roof was water-tight.

MR. POST said that it had been in use all winter, and he found it more satisfactory in this respect than a corrugated iron roof; in fact, it is absolutely water-tight.

MR. JACOBY spoke of the complete ventilation secured by the perfectly wide opening.

Meeting adjourned.

March 14th, 1892.

STATED MEETING.

In the absence of officers, PROF. REES was chosen to preside. Thirty-five persons present.

The minutes of February 29th were read and approved.

PROF. HENRY F. OSBORN read an illustrated paper on—

The Evolution of the Horse.

Meeting adjourned.

March 21st, 1892.

STATED MEETING.

The President, DR. HUBBARD, in the chair. Thirty-five persons present.

The minutes of March 14th were read and approved.

The sixth lecture of the Public Course was delivered by PROF. A. H. ELLIOTT, of the College of Pharmacy, on—

The Contributions of Organic Chemistry to Modern Medicine.

(Abstract.)

Of early observations in organic chemistry we know very little that is of special value to-day. A few observations are recorded by Pliny, such as the use of gallic acid for the detection of iron in verdigris. We also know that the Greeks understood the process of vinegar-making.

But one of the favorite operations of the early workers was the process of distillation in a variety of forms. They had an idea that this was the way to get the essence or soul out of everything in nature. The process was applied to a multitude of substances, solids and liquids. The products of these distillations were called spirits. Brandy was distilled from wine and called spirit of wine or aqua vitæ; ammonia was distilled from the shavings of stag's horns, and thus got its common name of spirits of hartshorn. Common salt distilled with oil of vitriol gave spirits of salt or what we call hydrochloric acid.

Previous to the fifth century the knowledge of chemical processes appears to be very scantily recorded, and what records we have are so confused and mixed up with mythological and cabalistic ideas that their true meaning is very difficult to make out.

But this process of distillation that I have spoken of—this subjection of substances to the effect of heat—led to a great many interesting results, especially in the preparation of various remedies for the alleviation of suffering in man. It was in the service of pharmacy and medicine that the earliest discoveries were made that led to the building up of the magnificent structure of modern organic chemistry.

Among the earliest workers in the preparation of medicines was Galen, an apothecary, who lived in Rome about the year 150 A. D., and his processes are the first that we know of for the preparation of the distilled volatile principles of plants. Certain herbs and plants were steeped in water and then subjected to the process of distillation, the volatile principles passing over with the steam and giving what we now know as distilled waters, such as peppermint-water, cinnamon-water, and similar products.

This process was not original with Galen, as it was probably known to the Egyptians, and was obtained from them by the Arabians, by whom it was also practised.

This idea of getting the essence or soul of substances out of substances by distillation led to some strange products. Every imaginable material was submitted to the process—snakes, toads, wolf's tongues, and even human brains.

Such crude processes continued to be used until about the seventeenth century. A change was then brought about in the methods of preparing medicines by Paracelsus. This man was a curious mixture of humbug and learning, but he was one of the first to make extracts, tinctures, and certain metallic salts for use in medicine.

After the death of Paracelsus the apothecaries or makers of drugs of that time became divided into two sects or codes of procedure: those who followed Galen and prepared drugs from vegetable substances, and the disciples of Paracelsus, who used both vegetable and mineral substances as they esteemed best for the particular case under treatment.

As in modern times, these sects of apothecaries had their disputes, and the Galenites of Paris had an edict passed prohibiting the use of any metallic remedies, thus seeking to crush the followers of Paracelsus. But this kind of warfare was destined to be of no avail, and the disciples of Paracelsus were ultimately successful in maintaining the use of mineral compounds, and chemistry entered the drug-store to remain until the present day.

The first book on the preparation of medicines was written by Oswald Croll, in the year 1608. He was a physician to the Prince of Anhalt, in Germany; and it was the first intelligent treatise published on this subject. Later, Nicholas Lémery, a druggist of

Paris, published a more complete treatise in the year 1675. These were the first glimmers of the dawn soon to break in chemical history, and especially in the domain of organic chemistry. Up to this time the work had been fragmentary and erratic. No particular line of research had been followed by any experimenters and no leading or intelligent course laid down for future work.

The reason for this dormant state of the organic side of chemistry is probably found in the development of metallurgy. The alchemists, who lived but for one object, the conversion of the base metals into gold, caused the drift of all experimental work in that direction; in other words, they encouraged the inorganic rather than the organic development of experimental chemistry. Nevertheless, certain truly organic substances were discovered and their properties pretty well known. But the healing art was almost exclusively confined to metallic compounds during the early part of the eighteenth century, and it took some time before organic medicines were used at all. Gradually organic bodies, especially plants, were used and their active principles separated from them. This led to the discovery of such bodies as succinic acid from amber, benzoic acid from gum benzoin, pyroligneous acid, the crude acetic acid, from wood, and sugar of milk from cow's milk.

Nicholas Lémery classified all substances under three heads, mineral, vegetable, and animal, according to their origin; and this was the best he could do.

Such was about the condition of affairs in chemistry until near the close of the last century (1774), when the Swedish apothecary, Karl Scheele, made the first important advances in the investigation of organic substances. Before this time all the organic chemical investigations had been made solely for the purpose of obtaining medicines and for the improvement of various technical processes, such as dyeing and calico-printing. Scheele had the true spirit of the scientific investigator, and made his experiments solely for the purpose of obtaining a better knowledge of the character of the materials that fell into his hands. He was the first to identify and separate nearly all the common vegetable acids. He proved that the acid of lemons (citric acid) was different from the acid of grapes (tartaric acid), and that malic acid (from apples) is different from either. He also separated and described the acid of wood-sorrel (oxalic acid), and proved that it could be made from sugar by means of nitric acid. Furthermore, he showed that another acid (lactic) of a totally different character was obtained from sugar of milk by the same treatment with nitric acid. From nut-galls he obtained gallic acid; and from urine, uric acid; and by treating fats with oxide of lead and water he obtained the sweet principle of oils—as he called it—glycerin, at the same time proving that by treatment with nitric acid glycerin will give the same product as ordinary cane-sugar, namely, oxalic acid.

Chemistry owes to pharmacy a debt of gratitude for showing the way to her modern fields of triumph, for the earliest and best workers in chemical science were practitioners of the healing art, either as pharmacists or as physicians. Stahl was a physician, Boerhaave was a physician, Scheele was an apothecary, Liebig an apothecary's apprentice; and you must also remember that all these men worked for the love of the science, and without any idea of the utility of their labors. Who can estimate the value of the discovery of chloroform and chloral? yet Liebig had no idea of making them useful when he discovered them. But this was the beginning of a new era in organic chemistry, and discovery followed discovery in such rapid succession that the disciples of the vital-force theory were obliged to give way to the cloud of witnesses taken from experimental chemistry proving the fallacy of their theories.

While Scheele, Bergman and Rouelle, and others were working experimentally upon organic substances, Lavoisier, the Frenchman, was watching their work, and, in connection with his experiments upon oxygen and combustion, was paving the rough and rocky road that led to modern researches. He it was who first proved how few of the elements enter into the constitution of organic substances; and, in the year 1793, he points out that while in the mineral kingdom a large number of elements enter into the constitution of substances, in the animal kingdom we have generally only carbon and hydrogen, and sometimes nitrogen and phosphorus. It is rather curious to note how near he was to the truth, with his limited knowledge of the elementary composition of organic bodies, for to-day we say that organic compounds contain, as a rule, only carbon, hydrogen, oxygen, nitrogen, and sulphur. Lavoisier had an idea that oxygen was confined to the mineral kingdom, and his methods of research had not taken into consideration animal products, like albumen, which contain sulphur. Nevertheless, he was the first chemist that saw clearly the special functions of carbon in the constitution of organic compounds.

Berzelius improved the methods of ultimate organic analysis, and by his indefatigable energy as an analyst made us better acquainted with a vast number of chemical compounds and their constituents; but he firmly believed that the essential elements of organic compounds were carbon, hydrogen, and nitrogen. Then came the discovery by Gay Lussac of the compound radicle cyanogen, which caused quite a flutter in the chemical world; but it was ultimately believed that this was really an inorganic rather than an organic compound; and Leopold Gmelin, in his great "Handbuch" in 1817, states that the difference between organic and inorganic bodies consists in the fact that the inorganic compounds can be prepared artificially from their elements, while the organic compounds cannot, and about the same time Berzelius enforced the statement by a sentence in the introduction to his "Treatise." He says: "In living nature the elements appear to obey very different laws from those in inorganic nature; the products which result from the action of these elements differ from those with which inorganic nature presents us."

In other cases the chemists of that time believed in the action of what they called a vital force, which acted in the formation of organic compounds and not in the case of inorganic compounds. They said it is easy to take organic substances to pieces and resolve them into simpler compounds, but to build them up from their elements was an impossibility without the intervention of vital force. Thus we could convert the complex substance grape-sugar into alcohol and carbon dioxide, but it took vital force to make the sugar in the grapes and other vegetable substances that contain it.

The first good blow against the vital-force theory was struck in 1828, when Wöhler succeeded in making urea artificially by boiling an alcoholic solution of ammonium cyanate, thus from purely inorganic materials building up a substance as truly organic as any we can find in the animal or vegetable kingdoms; but even this master-stroke of a master-hand did not at once overthrow the theory of vital force, although the best minds in the chemical world saw its power and the tendencies of the researches that would be made in the future.

Liebig, Berzelius, Dumas, and Boullay all worked upon organic bodies with a view to determine their constitution. The constitution of oil of bitter almonds, discovered by Liebig and Wöhler; the discovery of ethyl in alcohol by Berzelius and Liebig; the formation of aldehyde and acetic acid; formic acid from methyl alcohol or wood-spirit; the discovery by Liebig of chloride of methenyl or chloroform, and also chloral, all followed as the early fruits of this organic research.

And while we are talking of Liebig, it is interesting to note that his father was a wholesale druggist, and his own first knowledge of chemistry began while he was an apprentice to an apothecary at Heppenheim, near Darmstadt. It was in this position that he made some of his first experiments upon the fulminates, and having the misfortune to cause a great explosion his term of apprenticeship was soon ended. Liebig afterward made a number of interesting contributions to chemical knowledge. It was he that obtained picric acid from aloes, although aloin was not discovered and isolated until more recently. In 1829 Liebig discovered hippuric acid; but the work that made him most famous was his improvements in the methods of organic analysis In old times when a chemist wished to find out what a substance contained he put it into a retort and heated it, or, as we say, subjected it to dry distillation He then obtained a watery liquid, afterward some oily matters, and an alkali in the case of animal substances, which he soon learned was ammonia; but there were also obtained certain gases which he did not collect, and a mass of carbon remained in the retort. But Liebig had learned that organic bodies contained carbon, hydrogen, oxygen, and nitrogen, and he perfected the methods of estimating them, and, together with his pupils Will and Varrentrapp, invented the methods of analysis which we practise to-day.

In 1832 Liebig and Wöhler discovered the radical or parent substance of benzoic acid. They also noted that oil of bitter almonds could be oxidized and gave benzoic acid. It followed, therefore, that there must be some connection between benzoic acid and the oil of bitter almonds. It had been previously ascertained that benzoic acid could be obtained from aromatic gum benzoin. Then Mitscherlich, another chemist, found that by heating benzoic acid with lime he obtained benzol, a liquid hydrocarbon; therefore there must be some connection between this hydrocarbon and oil of bitter almonds, for the oil gives benzoic acid and benzoic acid gives benzol. Further, Mitscherlich converted benzol into benzoic acid again by oxidation. It was ultimately ascertained that oil of bitter almonds is an intermediate product between benzol and benzoic acid; and when Hoffmann discovered benzol in coal-tar in the year 1845 a source for making it artificially was obtained.

But to return to the vital-force theory.

In 1835 or 1836, Berthelot, the Frenchman, succeeded in uniting carbon and hydrogen and produced the hydrocarbon called acetylene, consisting of two atoms of carbon united to two atoms of hydrogen. This was accomplished by using a powerful electric battery, and allowing the sparks to pass between two carbon poles in an atmosphere of hydrogen gas. Here was an actual union of the very elements themselves to produce a compound characteristic of organic substances, a hydrocarbon that up to that time had only been obtained by decomposing organic compounds, such as carbonized tartar and water, wood-alcohol, and ether, by passing the vapors through red-hot tubes.

From this gas acetylene, the hydrocarbon ethene, or olefiant gas, was made by acting on it with nascent hydrogen. By absorbing olefiant gas in sulphuric acid a compound is formed which was called sulphovinic acid, or ethyl acid sulphate. When this is boiled with water we get ethyl hydroxide or alcohol and sulphuric acid. From this series of steps it is evident that, starting from the elements themselves, we are able to build up compounds that are entirely characteristic of organic substances, and this without the intervention of any vital force. This sounds rather complicated, but is only so in words. The process is simple.

It was in the efforts to obtain knowledge of the active principles of animal and vegetable substances used in medicines that many of the greatest discoveries in organic chemistry were made.

In 1803, Derosne, in Paris, discovered morphine and narcotine in opium, and called the mixture a salt of opium. He also knew it was a base like ammonia.

Sertürner, a German apothecary, in 1806, discovered that morphine existed in opium combined with an acid, called meconic acid. This discovery started the search for alkaloids in plants, as up to that time no basic substance had been found in plants and they were thought to be only capable of producing acids and organic salts of mineral substances; but this discovery of Sertürner opened a new field of inquiry, and a search for alkaloidal bodies in plants led to a rich harvest for the apothecary and physician. Conium, strychnine, cinchonine, quinine, cocaine, atropine, veratrine, and many others were soon separated from the plants that up to this time had been used as the active agents in the hands of the physician.

The bark of a tree from Peru was known in Europe as a specific for fever as early as the year 1640. In 1737, La Condamine, the botanist, in a journey through Lima, saw the tree and described it in the Mémoires of the French Academy. Soon afterward Linnæus gave it the name of Cinchona, after the Countess of Cinchon, who, it is said, was the first to introduce its use into Europe.

As early as 1803 efforts were made to separate the active principle from this cinchona bark, and several materials were made from it that were supposed to be this principle, but failed to produce the effects obtained by the use of the bark itself. These efforts continued for seventeen years, when, in 1820, Pellatier and Cavento isolated cinchonine and quinine and proved that these two substances would give the peculiar antifebrifuge results obtained from the Peruvian bark. This discovery led to the offer of a prize by the French Academy of Medicine of 20,000 francs to the individual who should be able to produce it artificially or without the use of Peruvian bark.

When we consider that in 1823, about the time this prize was offered, the price of quinine was $20 per ounce, it may be readily understood how important such a process as its artificial production would prove.

For a long time all attempts at the synthesis of quinine were pursued on the assumption that it was represented by the formula $C_{20}H_{24}N_2O_2$, and cinchonidine was taken as $C_{20}H_{24}N_2O$, so that the atom of O constituted the whole difference. Nothing seemed simpler than to tack on an atom of O to the cinchonidine and convert it into quinine. When this was effected, however, the resulting compound differed entirely from quinine, both in physical character and physiological action, so that it was obvious that the theory was wrong. To-day the annual production of the bark is worth between seven and eight millions of dollars.

In 1856, it was the desire on the part of Perkin, the English chemist, to obtain quinine from aniline that led to the discovery of the first of the aniline colors, namely, mauve. After the methods perfected by Liebig, Will, and Varrentrapp, the composition of aniline became firmly established, and it was the study of this analysis that first led Perkin into the idea that quinine could probably be made artificially. He failed to make what he wished, but who can estimate the value of the industry that started when in his search for the snowy-white alkaloid of cinchona he was disgusted when he obtained a dirty brown mass; but the next moment he was filled with joy when, on dissolving it in alcohol, he obtained that beautiful coloring-matter which he called mauve. From that simple experiment there started an industry that to-day is probably worth fifty millions of dollars to the world every year.

Owing to the brilliancy of the results of the researches of Perkin and Hofmann (who, by the way, was a pupil of the great Leibig), organic chemistry soon had an army of enthusiastic investigators delving into its secrets and unearthing new substances almost daily. The dyes and coloring-matters received a great deal of attention, and after a time both alizarine and indigo yielded to synthetic chemistry; and to-day there is not an organic compound that we can find the true constitution of that we cannot make in our laboratories.

I have spoken of aniline. Like the oil of bitter almonds it is derived from benzol, one of the products of coal-tar.

The benzol is first treated with nitric acid, making what we call nitrobenzol.

This nitrobenzol is next mixed with iron filings and acetic acid, when aniline oil, as it is called, is formed, and this is the basis of the aniline colors; think of the industry and wealth brought into the world by such simple experiments.

The first step in the successful imitation of a natural product is to ascertain with certainty its constitution, into what products it is most easily separated, and how these again break up into simpler ones already known Kolbe knew that salicylic acid could be readily converted into carbolic acid, carbonic acid being liberated. He reasoned, then, that if he could make carbonic acid act upon and combine with carbolic acid, salicylic acid would probably result. By the intervention of metallic sodium the reaction was accomplished; but sodium is too expensive a metal for such a purpose, hence he sought and found a cheaper one in caustic soda. What the latter lacked in energy was compensated for by simply raising the temperature.

Baeyer's recent synthesis of indigo is of no importance to the dyer at present, because his method is too circuitous and expensive; but it is no less the great achievement of a master-mind. Another may modify his method and make it profitable.

Baeyer's synthesis of indigo-blue furnishes a most instructive example of reversed operations. It had long been known that when indigo is oxidized with nitric acid *isatine* is formed; so Baeyer reasoned from this that he must be able to reduce isatine to indigo-blue, and in this he succeeded by the aid of phosphorus and chloride of phosphorus. The next step was to prepare the isatine. *Oxindole* can be made from isatine; therefore Baeyer thought he could make isatine from oxindole, and after a few unsuccessful efforts he finally succeeded in making isatine. This completed his research, for he had already made oxindole from phenylacetic acid, which in turn is made from some of the coal-tar products. The synthesis is complete, although tedious.

The artificial formation of oil of mustard is another triumph of synthetic organic chemistry. In distilling glycerin and oxalic acid the chief product obtained is formic acid; but the rest of the products of decomposition were unknown until Tollens, the chemist, undertook to investigate them. He found that, besides formic acid, there was also produced a considerable quantity of allyl alcohol. Now this alcohol is one of the principal constituents of oil of mustard, but nobody knew of an economical method of preparing it until Tollens showed that it could be produced from glycerin and oxalic acid. It can now be made in any quantity and readily converted into oil of mustard.

Citric acid, usually made from lemons and limes, can also be made artificially.

Glycerin is the starting-point.

Glycerin is treated with chlorine, and gives what is called a dichlorhydrin. This dichlorhydrin is oxidized with chromic acid, and gives an acetone; this acetone is treated with hydrocyanic acid, then with hydrochloric acid, then with sodium, then with potassium cyanide, and finally with hydrochloric acid, which gives citric acid.

Of course, the process is too complicated to be useful; but the synthesis or building up of the organic acid from glycerin is an accomplished fact.

Taurine, the acid of bile; salicin; piperidine, the active principle of black pepper; uric acid; tyrosine, a product of the spleen, liver, urine, etc.; vanilline, the aromatic principle of the vanilla bean; cumarine, of the tonka bean; daphnetine and umbelliferone, natural glucosides; and other bodies that it is unnecessary to mention, are all the products of modern organic synthesis.

Furthermore, in the search after the constitution of organic compounds we are often led to discover bodies, hitherto unknown to man, with many new and valuable properties.

At the beginning of the lecture I spoke of the use of distillation by the old chemists and apothecaries as a means of obtaining the active principles of substances. During the seventeenth century a man named Dippel applied this process to certain fetid animal oils, obtained from stag's horns, and the product was long known in the apothecary's store as Dippel's oil or bone-oil.

About the year 1846, Anderson, a Scotch chemist, discovered in this Dippel's oil certain basic oily bodies that resembled ammonia in their property of containing nitrogen. Little attention was paid to this fact.

In the year 1834, Runge, a German chemist, discovered a series of bases in the distillates from coal-tar; and about the same time, or a little later, Greville Williams, an English chemist, located these oily basic bodies and proved that they were pyridine and chinoline, or, as the Englishmen call it, quinoline.

In 1842, Gerhardt, the Frenchman, distilled quinine and cinchonine with caustic potash and obtained chinoline.

Later on, Professor A. W. Hofmann showed that the chinoline from quinine and cinchonine was probably the same as that obtained from bone-oil by Anderson and from coal-tar by Runge.

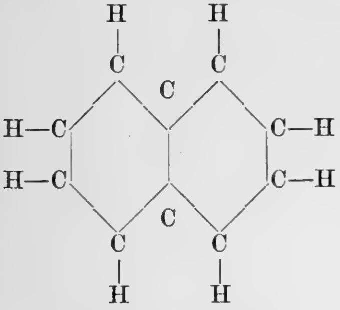
Here, then, was the first dawning light to show the way to make quinine and cinchonine artificially. This chinoline is evidently an important factor in the constitution of quinine in the same manner that aniline, another organic base, is an important factor in the production of aniline colors; but to-day we are not able to make quinine artificially.

As a result of the production of chinoline from quinine it is found that other alkaloids give this same oily base and its analogue, pyridine. It is therefore the belief of the chemist that we shall some day be able to make alkaloids from other sources than the plants from which they are derived. Thus the alkaloid of belladonna is a pyridine compound. In the year 1883, Hoogewerf and van Dorp proved that the chinoline from coal-tar and that obtained from quinine were identically the same substance. In the following year, 1884, Skraup discovered a process for making chinoline artificially. This was accomplished by heating together aniline, nitrobenzol, glycerine, and sulphuric acid.

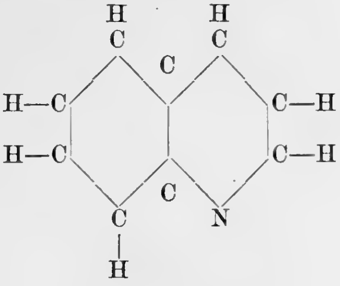
Hitherto the production of chinoline was dependent on the yield from bone-oil and coal-tar, and the amount obtained from these sources was small. But here was a process invented by Skraup in which it could be made in unlimited quantities. The result of the artificial production of chinoline was to stimulate research upon this body and its analogues; and the first fruit of these researches was the production of kairine, an alkaloid hitherto unknown to man and similar to quinine in its effect upon the human frame, although not good as an antiperiodic. It is really a pyridine compound. Another compound derived from the same base is thalline. This is another alkaloid of similar effect to quinine; that is, it reduces fever temperature, but its effects do not last so long.

Very soon after the artificial production of chinoline, antipyrine was made, and it has proved a most potent addition to the drugs of the pharmacopœia. This is a chinoline compound. It is a reducer of fever temperature to a remarkable extent, acting in 4 to 6 hours. It also is an analgesic, and reduces the sensibility to pain without complete anæsthesia.

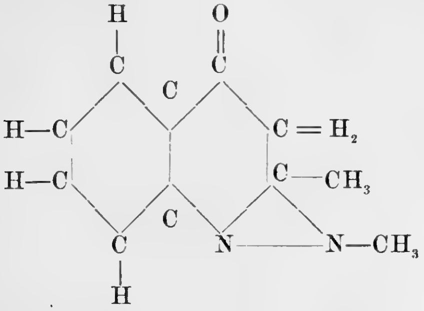
You note that I refrain from giving you any chemical formulæ of these new substances, but I will take antipyrine as an example—if you will allow me to torture you that much.



$C_{10}H_8$ Naphthalene of coal-tar.



C_9H_7N Chinoline of Skraup.



$C_{11}H_{12}N_2O$ Dimethyloxyquinazine = Antipyrine.

Thermifugin is another of these compounds. Hypnal is a compound of antipyrine with chloral. Salipyrine is a compound of antipyrine and salicylic acid. Iodol, a substitute for iodoform, is a pyrrol compound, one of the cousins of chinoline and pyridine.

The wonderful results obtained in the use of the chinoline and pyridine compounds stimulated experiments on other organic bodies made in the chemical laboratory by building up or synthesis.

I can only mention some of these by name. Among hypnotics and anæsthetics we have—

Methylal.
Amylene hydrate.
Para aldehyde.
Urethane.
Sulphonal.
Di and tri chlor methane.

Then we have a series of antiseptics allied to carbolic acid. These include—

Alpha-naphthol from naphthalene.
Beta- " " "
Tribromphenol or bromol.
Phenyl salicylate or salol.
Beta-naphthyl salicylate or Betol.
Aseptol-orthophenol sulphonic acid.
Sozoiodol-diiodophenolsulphonate.

Another series includes bodies allied to aniline, the substance that gives the well-known colors—

Antifebrine or acetanilide.
Phenacetine.
Pyrodine.
Antithermine.

Some of these bodies are not new to the chemist, but the synthetic production of some new alkaloidal substances led the physician to experiment with other products of the chemical laboratory, until to-day there are probably 200 materials used in medicine that ten years ago were curiosities in the chemical museum or totally unknown.

If we try to trace the therapeutic effects to some particular class of substances, we are in a very uncertain state of mind at the beginning of comparisons; but certain chlorine compounds derived from marsh-gas, such as chloroform, are usually hypnotics. In the list of antiseptics we have bodies called phenols, and this is the chemical term we apply to carbolic acid, long known as an antiseptic.

The antipyretics all contain nitrogen in a form similar to chinoline.

These are only general conclusions, and there are some important exceptions.

I have brought here to-night quite a number of specimens of these new contributions from the organic chemical laboratory, and I am indebted to Dr. Charles Rice, of Bellevue Hospital, and Messrs. Eimer & Amend, for lending me this interesting collection, which contains some of the latest additions.

You will probably ask yourselves the question, What is the limit to these productions? There is none. Perkin made the first aniline color in 1856, and to-day there are over 500 colors known. Ten years ago one or two of these synthetic remedies were known; to-day there are nearly 200 that have been used.

To-day we have not yet made quinine—one of the most remarkable and useful products of the vegetable kingdom—but there are hundreds of chemists working at the problem, and even while I utter these words some industrious worker may be recording experiments that will teach us how to make it artificially.

The lecture was illustrated by a large collection of new substances used in pharmacy and medicine.

DR. BOLTON expressed his appreciation of the very interesting and valuable paper by PROFESSOR ELLIOTT, and begged leave to call his attention to the fact that chloroform was discovered in America, as well as by Soubeiran, by Liebig, and by Dumas. Dr. Samuel Guthrie, of Sackett's Harbor, New York, obtained chloroform, in alcoholic solution, by distilling together chloride of lime and alcohol in 1831. He described the process in the January number (1832) of the *Am. J. Science* (Silliman), and in the July number of the same year he gives the method of obtaining the product free from alcohol. He called the substance "chloric ether."

Dr. Guthrie's discovery was certainly entirely original and independent of Soubeiran, who published his process in the *Ann. Chim. Phys.* for February, 1831. Guthrie's chloroform was first employed in medical practice by Dr. Eli Ives, of the Yale Medical School, in the same year. The name "chloroform" was subsequently given by Dumas.

Dr. Bolton said he mentioned these facts only that Americans might have the credit justly due them.

President Hubbard confirmed the statement of Dr. Bolton, and gave some interesting personal reminiscences of the experiments on the therapeutic effects of Guthrie's products.

At the close of the lecture, a vote of thanks was accorded Prof. Elliott, and the meeting adjourned.

March 28th, 1892.

Stated Meeting.

The President, Dr. Hubbard, in the chair. One hundred and twenty-five persons present.

The minutes of March 21st were read and approved.

The Secretary read the names of the following persons nominated as Resident Members:—

Mr. Robert Weir seconded by Capt. Casey, Dr. Paul Gibier seconded by H. J. Newton; the nominations were referred to the Council.

Mr. George F. Kunz read a paper entitled:—

Notes on the Minerals, Gems, and Ethnology of the Ural Mountains, as Observed during a Recent Trip,

illustrated by lantern views.

Meeting adjourned.

April 4th, 1892.

Regular Business Meeting.

The President, Dr. Hubbard, in the chair. Thirteen persons present.

The minutes of March 7th were read and approved.

The Secretary announced that the 13th Annual Exhibition of the

New York Microscopical Society would be held at the American Museum of Natural History, Friday evening, April 22d, from 7.30 to 11 P. M. Members of the Academy were invited to attend.

DR. HUBBARD gave an interesting account of Guthrie, the discoverer of chloroform (see Proceedings for June, page 149).

The Astronomical Section then organized, PROF. REES in the chair. The reading of the Section minutes was dispensed with.

The following papers were read:—

Report of Observations on Comet of 1892 (Swift) made at Columbia College Observatory.

BY PROF. J. K. REES.

The Rutherfurd Photographic Measures of the Stars about β Cygni.

BY HAROLD JACOBY.

After the reading of the papers, there was considerable discussion on the matter of delay in printing of the publications of the Academy.

Meeting adjourned.

April 11th, 1892.

STATED MEETING.

The President, DR. HUBBARD, in the chair. Thirty-five persons present.

The minutes of March 28th were read and approved.

DR. HUBBARD exhibited a print of glacial markings made direct from the stone in a printing press.

DR. H. CARRINGTON BOLTON read a paper on—

Chemical Arts in Bible Times.

(Abstract.)

Chemistry, considered as an art, dates its origin from prehistoric times; considered as a science, it is little more than one hundred years old. The attempts of man to improve his surroundings as respects diet, clothing, and domestic economy, familiarized him with certain phenomena now recognized as chemical. The necessity of securing weapons for war and for the chase, and the attempts to alleviate disease, stimulated the application of chemistry to metallurgy and medicine. Among the sources of information concerning the very earliest period is the Holy Bible, which contains a surprising number of facts and allusions to chemical arts.

The ancients were acquainted with seven metals, of which six are mentioned by Moses in a single verse (Numbers xxxi, 22): "Only the gold and the silver, the brass [*i. e.*, copper], the iron, the tin, and the lead," are to be purified by fire when captured as spoil from heathen nations.

Tubalcain, the seventh from Adam, seems to have excelled in metallurgy, and apparently aided his brother's musical taste by his skill. The remarkable passage in Job xxviii, 1, describing the occurrences of ores and their metallurgic treatment, is well known. With this can be compared Ezekiel xxii, 18. Jeremiah, in chap. vi, 28, seems to describe the process of cupellation of gold and silver.

Of the seven metals, gold is the most attractive, and, occurring native, was early known to men. It is named among the attractions of the Garden of Eden (Gen. ii, 12), and was manufactured into ornaments for personal decoration at a very early period. Of its abundance in King Solomon's reign, testimony is striking. (I Kings x, 21, and II Chron. i, 15.)

Silver was early used in currency (Isaiah xlvi, 6), and, as the pieces were not stamped, "wicked balances" and "deceitful weights" were unhappily too common. (Micah vi, 11.)

Copper, commonly called brass, is named by Moses as occurring in the Promised Land (Deut. viii. 9), and is compared in value to gold by Ezra (Ezra viii, 27). Its alloys were in common use.

Tin and lead were frequently confounded in early times, the latter being called "soft tin." The use of leaden tablets for inscriptions is graphically described by Job. (Job xix, 23.) Solder was known to the Israelites (Isaiah xli, 7) for repairing metallic trinkets.

Iron was much used in Bible times. Among the many articles manufactured of iron are "chariots" (Judges iv, 8), "spear-heads" (I Sam. xvii, 7), "axes" (II Sam. xii, 31), "yokes" (Jer. xxviii, 14), "idols" (Dan. v, 4), "thrashing instruments" (Amos i, 3), and "nails" (I Chron. xxii, 3). The "bedstead of iron" belonging to Og, King of Bashan, was probably a sarcophagus of stone. (Deut. iii, 10.) The liquid metal mercury is not mentioned in the Bible nor by Herodotus, though known to Dioscorides and to Pliny.

Besides their metallurgical knowledge, the ancients possessed much skill in general chemical technology; they knew well how to prepare fermented drinks, wine (Gen. ix, 20), and vinegar (Ruth ii, 14).

Beer was known to the Egyptians, and is mentioned by Xenophon as a drink of the Germans about 100 A.D.

The apothecaries' art reached a high stage of culture in Egypt, of which the famous Papyrus Ebers gives ample testimony.

Cosmetics were used by Hebrew women for frescoing their faces

(II Kings ix, 30), a custom still prevailing in the East. The art of dyeing fabrics in brilliant hues is among the most ancient of the chemical arts (II Chron. ii, 7). The luxury of the Israelitish women is well described by Isaiah in chapter iii, 18–23.

The ancients were acquainted with alum, salts of iron, and copper and alkaline carbonates, and used them in mordanting. They also knew brilliant pigments whose durability is unsurpassed. Besides these chemical bodies, the ancients used sulphur, borax, salammoniac, and saltpetre; but the word "niter" in the English Bible is not saltpetre; it is a translation of natron, which is carbonate of soda.

Lye is mentioned by Jeremiah (ii, 22), and soap by Malachi (iii, 2).

Gases as such were hardly recognized by the ancients; the Bible, however, contains one peculiar reference to carbonic acid gas. Solomon wrote: "As one that taketh off a garment in cold weather, and as vinegar upon niter, so is he that singeth songs to an heavy heart." (Proverbs xxv, 20.) This refers to the effervescence of carbonate of soda when acted upon by the acid of vinegar.

In the apocryphal work of an Alexandrine Jew, called the Wisdom of Solomon, a remarkable passage occurs which seems to foreshadow the fundamental laws of chemistry:—

"πάντα μετρῷ καὶ αριθμῷ καὶ σταθμῷ διέταξας." (Chapter xi, 20.)

"Thou hast ordered all things in measure and number and weight."

Two centuries succeeding the birth of Christ saw many illustrious men, Pliny, Dioscorides, Plutarch, Ptolemy, Galen; but the succeeding six centuries were unfruitful in scientific research, owing to the intellectual degradation accompanying the anarchy which prevailed in the political world. Chemistry became the "sacred art" or occult science, and was largely devoted to attempts at the artificial manufacture of precious metals, and the futile search for the Philosopher's Stone.

At the close of the paper the meeting adjourned.

April 18th, 1892.

STATED MEETING.

PROF. D. S. MARTIN in the chair. One hundred and fifty persons present.

The minutes of April 11th were read and approved.

DR. A. A. JULIEN, of Columbia College, delivered the seventh lecture of the Public Course on—

Elves of the Air.

The lecture was illustrated by lantern views.

At the close of the lecture the meeting adjourned.

April 25th, 1892.

STATED MEETING.

MR. JOHN TATLOCK, JR., in the chair. Twelve persons present.

The minutes of April 18th were read and approved.

The Secretary announced that PROF. ALLEN was unable to read his paper announced for the evening, on account of sickness.

DR. N. L. BRITTON read a Note on a Collection of Tertiary Fossil Plants from Cerro Pasco de Potosi, Bolivia, made by DRS. F. A. CANFIELD and ARTHUR F. WENDT, illustrated by specimens.

Meeting adjourned

May 2d, 1892.

REGULAR BUSINESS MEETING.

Vice-President DR. BOLTON in the chair. Twenty-five persons present.

The minutes of April 4th were read and approved.

The Secretary read the report of the Council recommending:—

1. The election of DR. PAUL GIBIER and MR. ROBERT WEIR as Resident Members.
2. The Formation of a Section of Biology.

The recommendations were approved, and the Secretary was directed to cast a ballot electing the proposed members.

The Secretary reported having cast the ballot, and the gentlemen were declared duly elected.

The Astronomical Section then organized, PROF. REES in the chair. Reading of the Section minutes was dispensed with. DR. M. I. PUPIN read a paper on—

Further Experiments in Connection with Vacuum Discharges.

DR. PUPIN's paper was illustrated by photographs of experimental and actual corona of the sun.

DR. BOLTON asked what were the gases he introduced into the vacuum flasks, and suggested that certain gases might produce light more easily photographed, provided the mechanical effects sought were secured.

DR. PUPIN said he used ordinary air and alcohol vapor, the latter giving a very white light.

PROF. REES spoke of the opportune character of DR. PUPIN's researches in their bearing on the theory of Schäberle.

MR. JACOBY exhibited a negative of the stars surrounding β-Cygni, which had been taken at Columbia College Observatory, April 19, 1892. A comparison of this negative with the results deduced from Mr. Rutherfurd's negatives of the same stars showed that the discrepancies between the latter and Argelander's *Durchmusterung* were due partly to omissions in the *Durchmusterung* and partly to insufficient sensitiveness of Mr. Rutherfurd's plates. Attention was particularly called to the stars numbered 27 and 28 in Mr. Rutherfurd's list. These two form a double on the Rutherfurd plates; and while they are plainly separated on the latter, on the Columbia College negative the image of the smaller star appears as a sort of elongation of the larger star image. This appearance may, however, be due to the enlargement of the images upon the very sensitive dry plates.

Vice-President BOLTON resumed the chair, and the Academy adjourned.

May 9th, 1892.

STATED MEETING.

PROF. J. K. REES in the chair. Sixty persons present.

The minutes of April 25th were read and approved.

MORRIS LOEB, Ph.D., of the University of the City of New York, was proposed as a Resident Member by Dr. H. CARRINGTON BOLTON; the nomination was referred to the Council.

The Secretary read the following papers by title:—

A Catalogue of the Fishes of the Pacific Coast of America, North of Cerros Island.

BY CARL H. EIGENMANN AND ROSA S. EIGENMANN.

Notes on the Phalangida of the United States.

BY NATHAN BANKS.

Coleopterological Notices. IV.

BY THOS. L. CASEY.

DR. L. H. LAUDY read a paper on—

Recent Researches on the Solar Spectrum,

illustrated by experiments.

The speaker briefly referred to the analogies between sound and light, and then showed that since the time of Newton investigations on the solar spectrum had been carried on by the most eminent men of science, as Herschel, Tyndall, Bunsen, etc.

The production of spectra by prisms and by gratings was explained, and also the apparatus used in photographing them. The work of Prof. Langley in measuring the actual energy of radiation by means of the Bolospectrometer and concave gratings was mentioned.

In 1812 Dr. Wollaston discovered the presence of dark lines in the spectrum, and in 1859 Kirchoff noticed the coincidence of the dark line of the solar spectrum with the bright line of the terrestrial, although some recent investigators have doubted their absolute coincidence.

Absorption spectra were next explained, and their production by the selective absorbing action upon white light when passed through gases, liquids, and solids.

Meeting adjourned.

May 16th, 1892.

STATED MEETING.

The President, DR. HUBBARD, in the chair. One hundred and fifty persons present.

The minutes of May 9th were read and approved.

PROF. OGDEN N. ROOD, of Columbia College, delivered the last lecture of the Public Course on "Color," illustrated. At the close of the discourse a vote of thanks was extended to PROF. ROOD, and the meeting adjourned.

May 23d, 1892.

STATED MEETING.

The President, DR. HUBBARD, in the chair. Seventeen persons present.

The minutes of May 16th were read and approved.

The following papers were then read:—

Sucrose, Dextrose, and Levulose; their Quantitative Determination when Occurring Together.

BY DR. F. G. WIECHMANN.

Commercial Oil-testing.

BY DR. H. T. VULTÉ.

Petrographical Notes.

BY JAMES F. KEMP.

I.

A Remarkable Erratic from Aurora, Cayuga Co., N. Y. Nearly a year ago, Professor J. W. Freley, of Wells College, Aurora, called the writer's attention to a remarkable rock that had been found by him as a boulder two feet or so in diameter, "in the bed of a small ravine only a few rods south of Wells College." Its angles are described as being quite well rounded. A moment's examination of a hand-specimen showed that it was something unusual, and more careful study of a larger supply which Professor Freley kindly supplied, has corroborated the impression. The rock belongs with the hitherto seldom described basic rocks, which lack feldspar entirely, have a glassy base, and have been called monchiquite[1] when possessing much olivine, and fourchite[2] when lacking

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[1] M. Hunter and H. Rosenbusch, Ueber Monchiquit, etc. Tsch. Min. u. Petrog. Mitth., xi, 1891, p. 445.

[2] J. F. Williams, Igneous Rocks of Arkansas. Ann. Rep. State Geol., 1890, vol. ii.

it. The rarity of these varieties is the warrant for the mention of a boulder whose home is unknown, but which it is to be hoped may be traced. The rock is formed by a dense grayish-black ground-mass, through which are thickly set great crystals of black hornblende and augite up to an inch or more in length, and at least half as much in width. In thin section the ground-mass proves to be glass, which is filled with minute colorless augites, about 0.1 mm. and less in breadth, and several times as long. The large hornblendes are golden-brown, parallel to c and b, and faint yellow, parallel to á. They fuse easily before the blowpipe with a strong sodium flame. The cleavage angle, as kindly determined by Mr. A. S. Eakle at the writer's request on a No. II Fuess Goniometer, is 123° 55′, and the signals were good. This would indicate arfvedsonite, the soda amphibole, and the cleavage angle is the same as that originally given by Brooke. There is also a cleavage parallel to the plane of symmetry, but it is less perfect. In the rock the crystals are bounded by the prism and this pinacoid. They are also faintly zonal, the border being a darker brown. The augite is eight-sided and almost colorless. There are some very doubtful olivine remains. Of all the rocks described, the fourchite which occurs with the elaeolite-syenite near Little Rock, Ark., is nearest to this. The source of the boulder is probably in the crystalline Archæan rocks to the northeast, and it has probably come from the Adirondack heights. The nearest exposure of these is distant a hundred miles at least, but of their petrographic character we know only in the most general way. It is also to be noted that peridotite dikes have been recorded in the interval, at Syracuse,[1] Manheim Bridge,[2] and south of Aurora at Ithaca.[3] Some undiscovered dike may have yielded the boulder. Professor Freley also gave the writer a piece of a small boulder that is a most excellent syenite. It indicates this rather unusual rock as existing in the northern crystallines, and increases the interest which should be felt in the study of the western Adirondacks.

II.

Notes on Several Rocks Collected by E. E. Olcott, E.M., near Gold Hill, Tooele Co., Utah. A series of rocks has lately been placed in the hands of the writer which was collected by Mr. Olcott on the western border of Utah, in the American Desert or on its confines. They are of sufficient interest in one or two instances to deserve mention. S. F. Emmons, of the 40th Parallel Survey, has recorded some notes of this region as it lay within his explorations

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[1] G. H. Williams, The Serpentine (Peridotite) occurring in the Onondaga Salt Group at Syracuse, N. Y. A. J. S., Aug. 1887, p. 137.

[2] C. H. Smyth, Jr., A Third Occurrence of Peridotite in Central New York; id. April, 1892, p. 322.

[3] J. F. Kemp, Peridotite in the Portage Sandstones near Ithaca, N. Y.; id. Nov. 1891, p. 410.

(vol. ii, p. 475), and the recent mining excitement in the vicinity of Deep Creek, a station on the old pre-railway stage route, has also prompted a brief sketch from W. P. Blake (Age of the Limestone Strata of Deep Creek, Utah, etc., Amer. Geol. Jan. 1892, p. 47, reprinted in the Eng. and Min. Jour., Feb. 27, p. 253). It appears that one of the Basin Ranges, the Ibapah, runs along the borders of Utah and Nevada, and consists in a large degree of limestones which Blake regards as Lower Carboniferous from the specimens of Productus contained in them. These are pierced by granite and other igneous rocks which have wrought extensive contact metamorphism in the limestones, and caused the formation of some interesting minerals briefly noted by Blake. Evidently the igneous rocks also pierce slates, as is shown by the following description of slide No. 6.

No. 1 of dike adjoining claim near Fish Spring Camp is rhyolite. It shows a microcrystalline ground-mass with some glass, abundant idiomorphic phenocrysts of quartz, a crystal or two of sanidine, and a very little biotite, sometimes bleached. Rhyolites have already been recorded by Emmons from the region.

No. 2, from a granite outcrop that forms the mass of Clifton Mountain near Gold Hill, is a hornblende granite with considerable plagioclase, and with apatite, and titaniferous magnetite.

No· 3, an altered limestone from Monaco, near Clifton, showed more physical than mineralogical changes.

No. 4, from the American Desert, between Dugway and Fish Spring, and about three miles east of Fish Spring, is a hypersthene-andesite of great beauty. The ground-mass is glass, with a few little plagioclase needles. The large plagioclase crystals are zonal and often full of inclusions of the groundmass. A grain or two of magnetite appear. Almost the only other mineral is hypersthene, in rounded prismatic crystals, of strong characteristic pleochroism, and in great abundance. The extinction is invariably parallel, and the optical properties such as would be expected. One stray augite was also detected.

Hypersthene was strangely overlooked by Zirkel in his report for the 40th Parallel Survey, but has been announced by Iddings to be quite widespread in the volcanic rocks of the Great Basin and the Pacific Slope.[1] Cross has also described an interesting occurrence in the Buffalo Peaks,[2] Colorada, and in the paper has given a quite complete review of the known localities for these rocks in other parts of the world. Up to the publication of his paper they were but few and often questionable.

No. 5, from two miles east of Rockwell's Ranch, Cherry Creek, is another andesite of different character. It has large brown

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[1] Hague and Iddings, Notes on the Volcanoes of Northern California, Oregon, and Washington Territory. A. J. S., Sept. 1883, p. 222. Also Volcanic Rocks of the Great Basin, idem, June, 1884, p. 453.

[2] C. W. Cross, Bulletin No. 1, U. S. Geol. Survey.

biotite, sometimes bleached, green idiomorphic hornblende, a very scarce augite or two, large zonal plagioclase, and magnetite. The ground-mass is glassy.

No. 6, from near the Kane Springs Mine, is a most excellent andalusite hornstone. The little chiastolite crystals, up to a millimeter or two in diameter, exhibit the dark crosses in the greatest perfection. There are also the indistinct beginnings of many others to be seen. They are set in a matrix which is without doubt an altered slate. The rock must have come from an altered zone of slate, near the contact with igneous rock. In this country andalusite in such relations has already been noted in the Willey Notch of the White Mountains as described in Hawes's classic paper,[1] and in less characteristic schists by G. H. Williams from the contacts of the Cortlandt series on the Hudson. In large crystals it is well known at Lancaster, Mass., but special petrographic descriptions remain to be written so far as known to the writer.

III.

On the Granite Quarried at Chester, Mass. Some facts in regard to the granite quarried by the Hudson and Chester Granite Co. at Chester, Mass , have lately come into my possession, and as they have both petrographical and economic bearings, they are here recorded. The interest attaching to building-stones and all reliable data regarding them will make the crushing-tests of value.

The granite is a very homogeneous, rather finely crystalline stone, of a bluish-gray color on polished faces and a much lighter tone on hammered ones. It is a true granite, being formed of quartz, orthoclase, green biotite, and muscovite in largest part with plagioclase and microline likewise present. There is almost no magnetite whatsoever, and in the slides no pyrite showed, although a few minute points could be found in the rock fragments, but, as the analysis shows, it is almost lacking. A sprinkling of titanite is present which has been derived from titaniferous magnetite, as a small core is now and then recognizable. Epidote, secondary after biotite, is occasionally met. All these minerals are intermingled in a very compact, allotriomorphic grouping.

An analysis which is the mean of two closely agreeing duplicates is appended. It was made by Professor L M. Dennis, of Cornell University, and the soda is given by difference, because in the NH_4Cl and $CaCO_3$ used in the determination of the alkalies some sodium was shown by the spectroscope.

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[1] Albany Granite and its Contact Phenomena. A. J. S., Jan. 1881.

Moisture at 110° C.	0.08
Loss on ignition	0.74
SiO_2	69.465
Fe_2O_3	2.30
Al_2O_3	17.50
MnO	trace
CaO	2.57
MgO	0.305
K_2O	4.07
S.	0.04
	97.07
Na_2O by difference	2.93

Crushing-tests were made on five sample cubes with the great Emory testing-machine in the School of Mines, and as preparatory to this the specific gravity was found on four cubes at 2.688, 2.687, 2.684, and 2.688. After three weeks' soaking these cubes absorbed water, respectively, 0.0021, 0.0021, 0.00224, and 0.0026 per cents. The crushing-tests gave the following results. The cubes were first ground and polished so that the faces next the jaws of the crusher were parallel within a limit of error of 0.005 inches. The cushion employed between the cubes and the jaws was blotting-paper.

	I.	II.	III.	IV.	V.
Height in inches	2.033	1.983	2.059	2.011	2.009
Breadth "	2.0	2.13	2.02	1.97	2.03
Thickness "	2.1	1.99	2.03	2.03	2.03
Area in sq. inches	4.2	4.23	4.1	4.0	4.12
Maximum compression in pounds	113,200	122,000	106,000	101,400	108,700
Crushing-strength per sq. inch	26,952	28,841	25,853	25,350	26,383

The cubes exploded without previous cracking. This strength is exceptionally high, as the general run of granite is far less. It does not, however, equal the elaeolite-syenite of Little Rock, Ark., which was tested by the late J. Francis Williams (see Annual Report of Arkansas State Geologist, 1890, vol. ii), where results of over 30,000 pounds were obtained; but it is far beyond the requirements of building.

Cubes of the rock were also boiled in acid. One which was thus treated for five hours in boiling dilute HCl (1 part HCl of specific gravity 1.20 to 20 parts H_2O) lost 0.59 per cent. in weight. A second cube treated in the same way in boiling dilute H_2SO_4 (1 part H_2SO_4 of specific gravity 1.84 to 20 parts H_2O) gave a loss of 0.48 per cent. Both these results indicate a great resistance to natural solvents. Two large cubes were placed in a muffle and maintained at a bright red for half an hour. One was allowed to cool just below redness and then plunged in cold water. It caused one crack that extended half through. The other cube was allowed to cool slowly in the air, and showed a thin, external, crumbling layer. When these results are compared with somewhat similar tests of other granites, as set forth by Mr. G. P. Merrill in his valuable work, Stones for Construction and Ornament, and with others in Volume I of the Final Report of the Geological Survey of Minnesota, and others by Dr. A. W. Jackson in the recent Annual Reports of the State Mineralogist of California, it appears that the Chester stone endured well.

It is much to be regretted that in miscellaneous tests of stone there is not some uniform course of procedure by which comparable data might be recorded. Some such generally accepted series would be welcomed by many observers.

The Secretary read the following by title:—

A Select Bibliography of Chemistry.

BY DR. H. CARRINGTON BOLTON.

The Secretary announced that the Academy would adjourn until June 6th, the next meeting falling on Decoration Day.

Meeting adjourned.

June 6th, 1892.

STATED MEETING.

The President, DR. HUBBARD, in the chair. Seven persons present.

The minutes of May 23d were read and approved.

As the Business Meeting failed of a quorum, all regular business was referred to the first meeting in October.

The Secretary read the following papers by title:—

Catalogue of the Described South American Species of the Calyptrate Muscidæ.

BY C. H. TYLER TOWNSEND.

The Paraguayan Plants Collected by Dr. Thomas Morong, 1888–1890.

BY N. L. BRITTON.

PROF. D. S. MARTIN read the following paper entitled :—

Notes on the Geology of Skunnemunk Mountain, Orange County, New York.[1]

BY CHARLES S. PROSSER.

[Published by permission of the Director of the U. S. Geological Survey.]

The geologic age of the rocks composing the Skunnemunk and Bellvale mountains in Orange County, New York, as well as their continuation in New Jersey under the names of the Bearfort, Kanouse, Copperas, and Green Pond mountains, has long been a question of great uncertainty. The complex geologic structure of the region, in connection with the almost total absence of fossils, has made it very difficult to assign these rocks to their proper position in the geological column. On this account a concise sketch of the various opinions that have been advanced as to the geologic age of this terrane may be of some general interest.

One of the earliest references to these rocks is contained in Professor Henry D. Rogers's report of 1836, where it is stated that under certain conditions "it becomes a little difficult to know it [the Green Pond Mountain conglomerate], at first sight, from the less calcareous varieties of the Potomac marble conglomerate [Triassic breccia]. In fact, it is possible that the two may be of coeval formation."[2]

The next reference is contained in the report of W. Horton "On the Geology of Orange County," New York, to W. W. Mather in 1839. It was stated that "Bellvale Mountain extends quite across the town of Warwick. The southeast side, the top, and about one-third of the descent on the northwest side are composed of graywacke and graywacke slate, standing nearly vertical. Its colors are gray, greenish- and bluish-gray, and brick-red. . . . .

"Skunnemunk is similar to Bellvale Mountain, passing unbroken nearly across Monroe. Its southeast side, top, and part of northwest side are graywacke in all the same varieties."[3] The geologic age was not stated.

Professor Henry D. Rogers was inclined to consider the New Jersey portion of this terrane as of Middle Secondary age, the name that he used for the Triassic red sandstone to which the name Newark group was given by Mr. W. C. Redfield.[4] Professor Rogers said: "From the wholly insulated position of these unconformable strata, encompassed on all sides by rocks of older date, and from the non-appearance hitherto of any organic remains of a distinctive kind, by which to infer their age and mode of origin, we are prevented from arriving at any very satisfactory views regarding

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[1] The drawing illustrating this article has been lost, and could not be reproduced in time to appear.

[2] Rep. on the Geol. Surv. of New Jersey, p. 130.

[3] N. Y. Geol. Survey, 3d Ann. Rept., 1839, p. 146.

[4] Am. Jour. Science, 1st ser., vol. xxii, p. 357. See Prof. I. C. Russell on "The Newark System," Am. Geologist, vol. iii, pp. 178–182.

the particular circumstances under which they were produced. The striking analogy which they bear, however, to the strata of the middle secondary series both in composition and appearance, and their lying in the same unconformable manner upon the previously uplifted rocks of the Appalachian group, induce us to consider them as deposits from the same mass of waters."[1] Accompanying this report is a "Section from New York to the Delaware River at Dingman's Ferry," and where it crosses the Copperas and Green Pond mountains the rocks are given as of Middle Secondary age; but on the "Geological Map of New Jersey," finished January, 1839, the formation was colored as the "sandstone and conglomerate of Green Pond Mountain."

Professor Mather, in the "Geology of the First Geological District" of New York, placed this terrane under the heading of "Rocks similar in character to the Shawangunk grit, and the interstratified and overlying red rocks." It was stated that "the observations on the geological survey of the First district of New York do not *quite demonstrate* the age of this rock; but if the red slates and grits on the east side of the Hudson, which are the same as those of Pine hill, in Cornwall, Orange county, are the same as those of Bellvale mountain near Long pond, and the Green-pond mountain, which they strongly resemble, and of which they appear to be an extension, they are older than the Middle Secondary sandstone (new red sandstone) of New Jersey, to which Prof. Rogers inclines to refer them, and are probably the geological equivalents, and in fact identical with the red rocks overlying and interstratified with the upper part of the Shawangunk grit."[2]

On the "Geological map of the State of New York," published in 1844, the region of Skunnemunk Mountain is colored as belonging to the Hudson River group.

The Green Pond Mountain rocks were described under that name by Professor George H. Cook in 1868 and referred to the Potsdam.[3] On the geological map showing the distribution of the Azoic and Paleozoic formations of New Jersey and Orange County, New York, the Green Pond, Bearfort, Bellvale, and Skunnemunk Mountain ridge is colored as Potsdam, while rocks lying to the east of Skunnemunk and Bellvale mountains and between Bearfort and Kanouse mountains are colored as of Hudson River age.

The first fossils in this formation were found by Professor Daniel S. Martin in a so-called coal mine on Skunnemunk Mountain, northwest of Monroe, Orange County, New York. On October 16, 1871, the Professor read a paper before the New York Lyceum of Natural History, on "The Coal of Orange County, New York," and stated that "the coal-mine of Monroe lies upon the western side, near the summit of an isolated hill known as Schunemunk

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[1] Description of the Geology of the State of New Jersey, being a Final Report, 1840, p. 174.

[2] Geology of New York, Pt. 1, 1843, pp. 362, 363.

[3] Geology of New Jersey, pp. 37, 73, 79–89.

Mountain. . . . Here an excavation has been made into the rock, which is a dark-gray, argillaceous sandstone, indistinguishable from the ordinary 'Hamilton flags.' Much of it is black with carbonaceous matter, but very little coal has yet been found, though the workings have been carried on for some months. The point of greatest interest, however, is the determination of the age of the rock from its fossils. These are for the most part obscure, being apparently mingled with the débris of a fragmental deposit; but enough has been obtained to fix the age as Devonian, and probably of the Hamilton Group. The forms are *Lepidodendron* (probably *L. Gaspianum*), *Calamites*, *Psilophyton*, and, Dr. Newberry thinks, *Dadoxylon*.

"The prospect of obtaining workable amounts of coal is not by any means flattering; but the scientific results are of much interest. Professor Cook, in his recent report on the geology of New Jersey, has considered this district to be lower Silurian, on the theory that the series ascends regularly, in going westward from the Highland range."[1]

On the geological map of northern New Jersey, published in 1874, this region remains colored as Potsdam, while the area called Hudson River group is given as Silurian Slates in the explanation of the "Columnar section of geological formations in New Jersey." Dr. T. Sterry Hunt stated in 1882 that he was disposed to regard the Green Pond Mountain conglomerate "as a portion of the First Graywacke or Upper Taconic."[2]

The geological map of New Jersey, published in 1882,[3] made no change from the 1874 map for the Green Pond—Bearfort Mountain region.

In 1884 Professor John C. Smock revised the previous statements as to the age of this terrane, and accepted the paleontological data furnished by the New York investigations. In the New Jersey annual report of that year the opening paragraph of Section VII, on the "Devonian and Silurian rocks," states that "A re-examination of the rocks of the Green Pond, Copperas, Kanouse, and Bearfort mountains, and the adjacent outcrops of slate, limestone, and gneiss, has brought out some facts which, taken in connection with the observations upon the same range in Bellvale and Skunnemunk mountains, in Orange county, New York, make it necessary to revise the descriptions of these rocks. Their geological horizon is not as low as was stated in the 'Geology of New Jersey,' in 1868, or as has been represented upon the several issues of State geological maps."[4] Then follows a good review of the previous opinions bearing on the age of this terrane; but there is no mention of Professor Martin's paper, which had evidently been overlooked.

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[1] Proc. Lyceum Nat. Hist., New York, vol. I, p. 259.

[2] Trans. Roy. Soc. Canada, vol. I, sec. iv, p. 254.

[3] Ann. Rept. State Geologist [New Jersey] for 1882.

[4] Geol. Surv. New Jersey. Ann. Rept. State Geologist for 1884, p. 29. This work is credited to Professor Smock on p. 156.

A "section from Woodcock Hill, southeast and east across Skunnemunk Mountain," is given,[1] in which it is shown that the structure of the mountain is that of a synclinal fold. Professor Smock says: "The synclinal structure of the Skunnemunk elevation has been shown in the profile, on page 46. The well-defined and normal type of a synclinal fold in this mountain, the order of superposition in the strata of shale, sandstone, and conglomerate, and the numerous and almost unbroken succession of outcrops from its base to crest line, make it typical of the whole range of Green-Pond mountain rocks. And its relations to the adjacent formations and its fossil organic remains give the clew to the geological age of the series."[2] A sketch map, showing the geological formations near Monroe, is given, the legend of which is "sandstone and conglomerate of Skunnemunk Mountain (Devonian);"[3] while the geological age is explained at some length in the text, the correlation being determined by means of fossil plants. The Professor says "the Skunnemunk Mountain range appears to afford satisfactory proofs and to give data upon which to base the age of these rocks. The section on page 46 shows a cross-vertical profile of the mountain from near Washingtonville to Mountainville, on a south and east line. The section exhibits the gneissic rocks on each side; the blue, magnesian limestone, the black (Hudson River) slate, and the (Oneida) conglomerate on the west, all having their beds dipping toward the southeast. The slaty sandstones and the thin-bedded grits, or gray sandstones (flagging-stones), are shown, with their inward dips, capped by the peculiar and characteristic red conglomerate. Here the conglomerate and the sandstone are seen above the Silurian slates and limestones. And the former have been preserved in this gently-folded synclinal. Elsewhere it must have been broken up in the uplifting and bending of the strata and afterward removed by glacial forces, which have left so many traces of their planing and polishing work on these hard rocks.

The occurrence of plant remains in this series has been referred to above. They are found in the gray-red, shaly sandstone of Skunnemunk Mountain. The locality where they can be most readily seen is at the Davison quarry, at the southwest point of the mountain and three miles northwest of Monroe.[4] A few fragmentary specimens have been found on the east side, also, and near Woodbury Falls.[5] These plant remains are identified as specifically the same with those collected and described by Professor James Hall, State Geologist of New York, and by Dr. Dawson, of Mon-

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[1] Op. cit., fig. 7, on p. 46.

[2] Op. cit., p. 51.

[3] Op. cit., opposite p. 52.

[4] Dr. J. S. Newberry, of Columbia College, N. Y., has identified the following species in a collection from this locality, now in the cabinet of Professor D. S. Martin, New York City: *Lepidodendron Gaspianum* (Dawson); *Psilophyton princeps* (Dawson); *Calamites transitionis* (Gœppert).

[5] In a collection of plant remains made in the autumn from these localities, rhizomes of the Psilophyton abound. A species of Calamites also appears.

treal, from localities in central and southern central New York, which are recognized as Hamilton and Chemung or Middle Devonian. That these rocks resemble, lithologically, some of the flagging-stones of the Hamilton in Ulster, Sullivan, and Greene counties is evident at once on a cursory examination. The absence of any remains of animal life leaves the full proof of geological equivalency in doubt. The great thickness of conglomerate at the top, and the prevalence of gray and green shales, with the red shales and sandstones, look more like the Catskill rocks or Upper Devonian. It is safe, however, to put them in the Middle Devonian."[1] Professor Smock also measured the thickness of the Devonian rocks of Skunnemunk Mountain, and considered them from 1300′ to 1600′ in thickness. It was stated that "In the east and west slopes of Skunnemunk mountain, New York, the strata are beautifully laid bare in the beds of small streams, and, as the dips are at small angles, the height of the crest above the valleys on each side approximates to the thickness of strata in these sections. The highest crest has a maximum elevation of 1600 feet above tide level; the valley on the west is about 600 feet; that on the east 300 feet, making a difference of 1300 feet for the height of the mountain. A still better exposure of these rocks is seen on the road west, descending the mountain from the Seven Springs Mountain House. This section, three-quarters of a mile long, shows a nearly unbroken succession of ledges, whose beds have a nearly uniform dip of 20° toward the east-northeast. Allowing for the difference in the length, as measured on the line of the dip, and taking 20° as the mean descent of the strata, the thickness, as computed for these elements, would be at least 1300 feet. If to this figure be added 300 feet for the conglomerate, which is not in the section, there is a total of 1600 feet."[2]

This report was reviewed by Mr. N. H. Darton,[3] who has added somewhat to Professor Smock's historical account of the formation, and who has spent a considerable amount of time in studying the structural relations and mapping this series of rocks. The discovery of fossil plants and their evidence as to the geologic age of the formation were mentioned by Dr. Hunt in 1886.[4]

In 1886 Professor F. J. H. Merrill studied this series of rocks in New Jersey; and in the blue limestone below the Devonian sandstones and shales he was fortunate enough to find a few species of Lower Helderberg fossils, as *Spirifera Vanuxemi*, *Chætetes Helderbergiæ*, etc.; while in an overlying calcareous conglomerate and siliceous grit are Oriskany and Upper Helderberg (Corniferous) fossils.[5]

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[1] Op. cit., pp. 54, 55.

[2] Op. cit., p. 56.

[3] Scientific American Supplement, vol. xix, June 13, 1885, pp. 7877, 7878.

[4] Mineral Physiology and Physiography, p. 591.

[5] See Geol. Surv. New Jersey, Ann. Rept. State Geologist for 1886 (1887), pp. 113, 114.

Professor Merrill proposed the following classification for this series of rocks:—

"Graywacke-slate.	Bearfort and Schunemunk mountains,	700 ft.	Hamilton.
Blue Argillite and Graywacke.	Longwood and West Milford valleys.	1000 "	
White Calc. Conglomerate and Siliceous Grit.	Newfoundland, Upper Longwood, and Pickatinny.	50 "	Corniferous. Oriskany.
Blue Limestone with Fossils.	Upper Longwood, Milton, Newfoundland, etc.	200 "	Lower Helderberg.
Red Shale.	Newfoundland, etc.	200 "	Medina.
Red Conglomerate	Green Pond mountain, etc.	600 "	Oneida.
		2750 ft."[1]	

In the graywacke slates at Clinton Falls, about one and one-half miles N.N.W. of Newfoundland, N. J., Professor Merrill states that "there seem to be traces of plant impressions in them, and they may correspond to the beds in Orange county, New York, which have yielded *Psilophyton princeps*, and other Devonian plants; that they are of Devonian age is beyond question."[2]

The "Geological Map of New York City and Vicinity, by D. S. Martin, 1888," gives the region of Green Pond and Bearfort mountains, New Jersey, as belonging to the Upper Silurian and Devonian periods. In the "Legend" the green color is stated to represent the Upper Silurian, the "Green Pond Mountain formation," which is given in parentheses as of Oneida and Medina age. The green color is spread over the Green Pond, Copperas, Kanouse, and Bearfort mountains; while in the valleys partly between these mountains is the brown color which represents the Devonian and is explained as "Slates, Hamilton in part (mingled with Ordovician B.)." The division B. of the Ordovician is given in the legend as "Slates and shales (Hudson River)." In the explanation of this map Professor Martin states, "It is now known that the 'Green Pond Mountain' series, long supposed to be of Potsdam age, is really at the base of the (upper) Silurian, and represents the Oneida and Medina rocks of New York State, or the Levant (No. 4) of the First Pennsylvania Survey. The heights here are, therefore, 'Mountains of Four,' and are colored accordingly. They doubtless rest upon Ordovician beds, which are seen outcropping at a few points on the eastern edge, and forming an island in Greenwood Lake, close to the State line. But the slates and shales of the adjacent valleys are the most uncertain ground in the map. They were long called Hudson River, but now are proven to be, at least in part, of Hamilton age. What portions, however, are such, and what may be still regarded as Ordovician, are points that are as yet unknown, and will require careful field-work to determine."[3]

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[1] Op. cit., p. 114.
[2] Op. cit., p. 119.
[3] Geological Map of New York City and Vicinity, by Daniel S. Martin, Notes and Explanations, p. 4.

On the "Geological Map of New Jersey," by George H. Cook, published in 1889, the geological discoveries stated above seem to have been ignored; for Bearfort, Green Pond, and Copperas mountains are apparently colored as belonging to the base of the Lower Silurian, which would make their age about the same as stated by Professor Cook in 1868, while that part of the area colored as Hudson River Slates on the earlier maps remains unchanged.

Professor Lester F. Ward, in his memoir on "The Geographical Distribution of Fossil Plants," quotes as follows from a letter written by Prof. I. C. Russell, November 2, 1887: "Mr. N. H. Darton is authority for the occurrence of Devonian plants near Monroe and Woodbury Falls, Orange County."[1] In Prof. Russell's letter, which Professor Ward has kindly shown me, it was also stated that Mr. Darton had found Devonian plants near Newfoundland, Morris County, New Jersey. Mr. Darton informs me that this locality was near Clinton Falls, but that the plants were in a very fragmentary condition and not nearly so well preserved as those near Monroe, New York.

In Macfarlane's Railway Guide, Mr. Darton has briefly described the Skunnemunk Mountain region as follows:—

"*Monroe.*—A mile west of the station a synclinal holding middle Devonian is crossed, but no outcrops are visible from the cars. These rocks extend for many miles southward into New Jersey. In New York they form Bellvale Mountain to the Erie Railroad, and thence extend northward in the high, rough, double-crested ridge known as Schunemunk Mountain. The lower members are flagstones and slates, the upper a coarse pebble conglomerate. In a flagstone quarry, two miles N.N.W. of Monroe, the remains of Devonian plants are quite abundant."[2]

In July, 1890, the writer stopped at Monroe, spent three days in searching for fossils on Skunnemunk Mountain and obtained certain facts which perhaps deserve to be recorded.

About one and one-half miles northwest of Monroe, near the base of Skunnemunk Mountain, is a small quarry on Mr. Ogden Cooley's farm. The New York, Lake Erie and Western Railroad at Monroe is 613′ A. T.,[3] and this quarry is 45′[4] higher. There is a ledge of coarse-grained, gray sandstone with blue argillaceous shale, and in places the shale is somewhat concretionary, containing clay pebbles. The dip is heavy to the east, a line along one of the joints, which may not be the true dip, gives a dip of 35° north of east.

In the shales are remains of fossil plants, most of which are quite fragmentary. The common form is *Psilophyton princeps* Dn., of which there are numerous broken specimens, and in addition, ir-

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[1] Eighth Ann. Rept. U. S. Geol. Surv., 1889, p. 859.

[2] Amer. Geol. Railway Guide, 2d ed., 1890, p. 132, note 129.

[3] Elevation furnished by Mr. Carl W. Buchholz, Civil Engineer of the N. Y., L. E. & W. R. R.

[4] Elevations from the railroad up the mountain are barometric.

regular bifurcating impressions, probably aërial roots of a calamite or fern.

Fossil wood was also found near this ledge which was apparently contained in a concretion and called the "fossil trees" by Mr. Cooley. The specimen obtained from this locality has been studied by Professor F. H. Knowlton, Assistant Paleontologist of the U. S. Geological Survey, and he identifies it as *Celluloxylon primævum* Dn.

Since neither the geographic distribution nor the geologic range of the two species identified from this locality is considerable, it may be valuable for the purpose of correlation to cite all those references which furnish data bearing upon these two points.

Psilophyton princeps was described by Dawson in the Quart. Jour. Geol. Soc., London, vol. xv, Pt. I, 1859. The genus was described on p. 478; figs. 1a–1i were given on p. 479, 1i being a restoration, and sections of stems figs. 1k–1n, p. 480; while the specific name was proposed on p. 481. The specimens were reported from the lower or middle Devonian of Gaspé, Lower Canada. In this paper, on p. 482, Dr. Dawson mentions fossil plants previously described that may belong to this species. First is the plant figured by Vanuxem in 1842 (Geol. New York, Pt. III, p. 161), from a quarry west of North New Berlin [now New Berlin], Chenango County, New York, which is in the upper part of the Hamilton. "Dichotomous roots from Orkney and Caithness," described by Salter, and "bifurcating plants with curved tendrils like branchlets figured by Hugh Miller" from the Old Red Sandstone of Scotland, are considered as belonging to this genus. Also, *Haliserites Dechenianus* Göpp., in the Lower Devonian of Rhenish Prussia, is considered a plant of this genus (op. cit., p. 483).

Dawson, Canadian Nat. and Geol., vol. vi, June, 1861, p. 175, reported the species from Perry, Maine, and on p. 179 doubtfully from St. John, N. B.

Dawson, Quart. Jour. Geol. Soc., vol. xviii, 1862, pp. 298, 315, 326, gives a more complete account of the range and distribution of the species. On p. 315 it is stated that the species is characteristic of the whole Devonian system at Gaspé, and "fragments which may have belonged to it occur in the Upper Silurian." It is also mentioned from Perry, Maine, which, in the table on p. 326, is called Upper Devonian; from the Hamilton at Schoharie, N. Y., and Akron, Ohio (Professor Hall, 16th An. Rept. Regents Univ. State N. Y. on Cond. State Cab. Nat. Hist., Appendix D, 1863, p. 108, foot-note, states that "The beds at Akron are of the age of the Chemung, of New York, or the Waverly sandstone of Ohio"), and from what is called the Chemung at Cascade Falls. [It is not stated whether Cascade Falls is in Ohio or New York, and the locality seems to have been lost. Dr. J. M. Clarke writes me that "The locality of 'Cascade Falls' is unknown to both Professor Hall and myself." While Sir Wm. Dawson says, "I am afraid I cannot be sure of the locality of the specimens from Cascade Falls, but I think it must have been New York, as I do not remember specimens of that kind from Ohio."] Finally, from the Catskill, at Jefferson, Schoharie County, N. Y., while in an "additional note, October 23, 1862," opposite p. 329, the age of the Jefferson horizon is changed to Chemung. [This locality is now considered as of Hamilton age, Am. Geol., vol. vii, p. 356, foot-note.] Rhizomes are reported from Fullenham, Schoharie County [probably Fultonham, which is Hamilton], and at Cazenovia [Madison County, and also of Hamilton age].

Dawson, Quart. Jour. Geol. Soc., vol. xix, 1863, pp. 461, 462, states that he has very imperfect specimens from Perry, Maine, which he somewhat doubtfully identifies as belonging to the three species *P. princeps*, *P. elegans*, and *P. glabrum:* on p. 465, see pl. xviii, Figs. 22a–22g, is a description of the rhizomata of *P. princeps*, which are stated to be from "the marine limestones at the base of the Gaspé sandstones, constituting the lowest members of the Devonian series, if they are not Upper Silurian."

Hall, 16th Regent's Rept. on State Cab. Nat. Hist., 1863, p. 111, fig. 2, reproduces Vanuxem's figure of a fossil plant [Geol. N. Y., Pt. III, p. 161, fig. 40], and calls it *P. princeps* Dn. on p. 110.

Dawson, Geol. Surv. Canada, Foss. Plants Dev. and Up. Sil., 1871, pp. 38, 39, describes the variety *ornatum* of *P. princeps* from Gaspé, and gives good figures of it on pl. ix, figs. 97–110; while on pl. x, figs. 111, 118–120, and pl. xi, figs. 127–129, 133, 134, are additional figures illustrating the structure of *P. princeps*. On p. 76 it is stated that from the Middle Devonian of Scotland are "fragments referrible to *Psilophyton princeps*," and on p. 77 a specimen, "apparently *P. princeps*," is mentioned from the Devonian of Northern Scotland.

Peach, Trans. Edinb. Geol. Soc., vol. iii, Pt. II, 1879, pp. 150, 151, identifies this species from the Old Red Sandstone of the island of Stroma, Pentland Firth, and from several localites in Caithness, northern Scotland.

Zeiller, Bull. Soc. Géol. de France, 3d ser., vol. viii, 1880, p. 504, mentions a specimen from the Devonian of Caffiers, France, which he compares with one of Dawson's figures of *P. princeps*, although he is inclined to consider it nearer *Lepidodendron gaspianum* Dn.

Dawson, Foss. Plants Erian (Dev.) and Up. Sil., Pt. II, 1882, p. 103, reports this species from the Lower Devonian of Campbellton, northern New Brunswick, as well as on the opposite side of the Restigouche River in the Province of Quebec.

J. C. White, 2d Geol. Surv. Penna., G^7, 1883, p. 307, mentions "vegetable fragments which resemble *Psilophyton princeps* Dn." from what is called upper Chemung, two miles above Danville, Montour County, Penna.

Kidston, Cat. Palæozoic Plants British Mus., 1886, p. 233, calls the plant figured by Vanuxem in 1842 the "earliest figure of

Psilophyton Dechenianus with which I am acquainted," and he makes the *P. Dechenianus* (Göpp.) Carr. include as a synonym the *P. robustius* Dn.

Weiss, Zeit. Deutschen geol. Gesellschaft, vol. xli, 1889, p. 168, stated that he considered the *Drepanophycus spinaeformis* Göpp. (Nov. Act. Acad. Caes. Leop.-Car. Nat. Cur. vol. xxii, Supplement, 1852, p. 92, pl. xli, fig. 1) as belonging to that part of the genus Psilophyton which includes *P. princeps.* Weiss proposed, since it is claimed by Soms-Laubach that *P. princeps* and *P. robustius* are generically distinct, to restrict the genus Psilophyton to *P. robustius* and allied forms, and since Drepanophycus would be a misnomer in reference to the systematic position of the fossil, to substitute Drepanophytum for *P. princeps.* Dawson, op. cit., p. 553, answers the proposition of Weiss, and states that he does not consider Drepanophycus as a Psilophyton, but thinks it is possible that it may be identical with his Arthrostigma. It is quite safe to say that Göppert's figure of *D. spinaeformis* bears very little resemblance to the Canadian specimens of Psilophyton, with which American paleontologists are well acquainted, thanks to the descriptions and generous distribution of specimens by Sir William Dawson. Finally, as to the question of priority, Dawson (op. cit., p. 554) shows concisely and correctly that Drepanophytum Weiss would date from 1889, and not from 1852, when Drepanophycus was described by Göppert. Weiss answers Dawson's letter (op. cit., p. 554) and reaffirms his previous opinion as to the division of Psilophyton into *Drepanophytum spinaeforme* and *D. princeps* and *Psilophyton robustius*, etc. (op. cit., p. 555).

Dawson, Nature, vol. 41, April 10, 1890, p. 537, identifies this species from the Old Red Sandstone of Perthshire, Scotland.

Prosser, Am. Geol., vol. vii, 1891, p. 365, reported specimens from Kaaterskill Clove, in the eastern Catskills of Greene County, New York, from a horizon several hundred feet above what has been considered the base of the Catskill; but the writer's studies in eastern New York lead him to consider the lower portion of the so-called Catskill in this region as of an age equivalent to the Chemung and Portage of southern and western New York.[1]

From the above review it will be seen that *Psilophyton princeps* Dn., when compared with other Devonian species of fossil plants, has quite an extended distribution and is most abundant in the Lower and Middle Devonian, but also ranges from the Upper Silurian to the Upper Devonian of Gaspé, occurs in the Upper Devonian of eastern New York (doubtful Catskill), and is reported from the sub-Carboniferous (Waverly) of Ohio.

Celluloxylon primævum genus and species described by Dawson

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[1] Oct. 1, '92. See account of Professor Hall's paper before the Rochester meeting of the Geol. Soc. of America on the "Oneonta Sandstone," in which it is stated that the "Oneonta sandstone passed eastwardly into the lower Catskill and westwardly into the Portage." Am. Geologist, vol. x (September, 1892), p. 194.

(Quart. Jour. Geol. Soc., vol. xxxvii, 1881, p. 302) "from the Hamilton (Middle Erian) of Canandargua [Canandaigua], New York." Dawson stated that "It was undoubtedly a woody stem, and not an alga. . . . It adds another to those mysterious woody stems of doubtful affinities which, in the Devonian or Erian of both sides of the Atlantic, represent the Taxineæ and conifers of later formations."

In a letter dated July 25, 1889, Professor J. M. Clarke, who found the type specimen, gave me the following note about this interesting fossil. "The *Celluloxylon primævum* Dn. was from the Hamilton shales in the town of Hopewell, Ontario County [Hopewell is the first township east of Canandaigua township]. The original specimen is a fragment happily saved from destruction, and a mere remnant of what must have been a magnificent affair,—a trunk ten feet long. This unique specimen was smashed up by a farmer to use as drain-stone and buried out of sight and knowledge."

Penhallow, Trans. Roy. Soc. Canada, vol. vii, sec. iv, 1889, p. 26, stated that he considered this plant only a highly altered condition of Nematophyton, and referred it provisionally to *N. crassum* (Dn.) Pen. On p. 29, *Celluloxylon primævum* Dn. is given as a synonym of *Nematophyton crassum* (Dn.) Pen., without a query.

Penhallow, Canadian Rec. Science, vol. iii, 1889, p. 431, says this species is "referred, on geographical grounds as well as of probable structure, to *N. crassum.*"

The *Nematoxylon crassum* Dn., which is put by Professor Penhallow in the genus Nematophyton, was described by Sir Wm. Dawson in Proc. Quart. Jour. Geol. Soc. London, vol. xix, 1863, p. 466, from Gaspé, Canada. In Dawson's Foss. Plants Dev. and Up. Sil., 1871, pp. 20, 85, it is given as from the Middle Devonian of Gaspé.

Carruthers, Month. Mic. Journal, vol. viii, 1872, pp. 161, 172, gave *Nematoxylon crassum* Dn. as a synonym of *Prototaxites Logani* Dn. which Carruthers called *Nematophycus Logani*, and Penhallow refers the latter to the genus Nematophyton (Trans. Roy. Soc. Canada, vol. vi, sec. iv, 1889, pp. 36, 44; and *ibid.*, vol. vii, sec. iv, 1889, p. 28).

Part of the specimen of Celluloxylon found at the base of the Skunnemunk Mountain has been given to Professor Penhallow, who has written a paper entitled "Notes on *Nematophyton crassum*," based principally upon this material. After describing sections of the specimen, the Professor says: "Comparing this specimen with the type of *Nematophyton crassum*, we find it agrees in all respects, except the presence of intercellular filaments in the latter and not in the former. But this difference may safely be attributed to the operation of greater alteration in one case than in the other, and it is, therefore, admissible to consider that my reference of *Celluloxylon primævum* to *Nematophyton crassum* is not only correct, but that it receives striking confirmation from this specimen."[1]

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[1] Proc. U. S. National Museum, vol. xv.

Near the southwestern end of Skunnemunk Mountain, about two and one-half miles north-northwest of Monroe, and one-fourth mile southwest of the Seven Springs Mountain House, are the Davidson quarries. The lower quarry is approximately 290′ higher than the Cooley quarry, or about 750′ A. T. An excavation has been made in the ledge at a place just north of the highway, and the eastern wall of the quarry is ten feet high. Some bluish-gray flagging-stone has been taken out, but a considerable part of the quarry is composed of shaly gray arenaceous layers. At the northeast corner are two layers containing fossil plants, which are separated by a stratum of the bluish sandstone. The plants are generally in the more argillaceous layers, although specimens poorly preserved are occasionally seen in the coarse, bluish-gray sandstones. In this quarry, which may be called the lower Davidson, specimens of *Psilophyton princeps* Dn., *Calamites* sp., and aërial rootlets of Calamites (?) occur.

A short distance northeast of the lower quarry and a little higher is the Davidson "Coal Mine" quarry, from which Professor Martin's plants were collected. The quarry has been opened to a considerable extent, the wall of rock being twenty feet high on the eastern side. The dip is apparently to the northeast, but on account of false bedding and thinning of the layers it is difficult to determine the amount and direction. Considerable bluish-gray flagging-stone has been removed from this quarry, and in lithologic characters it resembles closely the Hamilton flagging-stone of Ulster and Greene counties, New York.

No fossils were found except plants, and these are quite abundant in certain layers of the quarry. The most common species is *Psilophyton princeps* Dn.

The plants collected by Professor Martin probably came from this quarry, and through his kindness the writer has had the pleasure of examining a portion of the collection. Specimens of the *Psilophyton princeps* Dn. from this quarry have been examined by Sir J. Wm. Dawson and Professor D. P. Penhallow, and they agree with the above identification. From Professor Martin's collection, specimens of the Lepidodendron, Calamites, and Dadoxylon identified by Dr. J. S. Newberry as *L. gaspianum* Dn., *C. transitionis* Göpp., and *Dadoxylon* (?)[1] were submitted to Dr. Dawson. Principal Dawson agrees with Dr. Newberry in the identification of the Lepidodendron; the Calamites he would call *C. radiatus* Brongn., regarding *C. transitionis* as a synonym of the preceding, and the Dadoxylon he calls the aërial roots of a Calamite or fern.

The distribution and range of *Calamites radiatus* Brongn , also frequently called *Bornia radiata* (Brongn.) Sch., and *Archæocalamities radiatus*, (Brongn.) Stur, including *Calamites transitionis* Göpp. as a synonym, are quite extended, and no attempt has been made to verify the numerous reported identifications of this

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[1] Proc. Lyc. Nat. Hist., N. Y., vol. i, p. 259; and An. Rept. State Geol. (New Jersey), for 1884, p. 54.

species.. It is reported doubtfully in the Hamilton group, probably of New York (Dawson, Quart. Jour. Geol. Soc., vol. xviii, 1862, p. 309); in the Subconglomerate of Pennsylvania, Tennessee, Alabama, and Arkansas; in the Upper Devonian of Canada and New Brunswick; in the Devonian of England, Scotland, Ireland, Prussian-Saxony, Belgium, and Silesia; in the sub-Carboniferous of Moravia, Bohemia, Saxony, Silesia, Hesse, Alsace, Prussian-Saxony, Russia, Styria, Belgium, Siberia, Spitzbergen, Bear Island, and Australia; in the Carboniferous of France, Carinthia, Silesia, Westphalia, and Hannover; and in the Permian of Scotland, Bohemia, and Saxony.

Lepidodendron gaspianum was described by Dawson in the Quart. Jour. Geol. Soc., vol. xv, Pt. I, 1859, pp. 483, 484, Figs. 3a–d, from the Devonian of Gaspé, Lower Canada, now known as the Province of Quebec.

Dawson, Can. Nat. and Geol., vol. vi, June, 1861, p. 174, reported the species from Perry, Maine, which is now called Upper Devonian by Dawson (Fos. Plants Erian and Up. Sil., Pt. II, 1882, p. 97; The Geological History of Plants, 1888, p. 107), and stated by Professor L. W. Bailey to resemble most nearly the Catskill of New York (Proc. and Trans. Roy. Soc. Canada for 1889, vol. vii, 1890, Sec. IV, p. 60).

Dawson, Quart. Jour. Geol. Soc., vol. xviii, 1862, pp. 312, 313, pl. xiv, figs. 26–28; pl. xvii, fig. 58, reported the species from the Middle and Upper Devonian of Gaspé, (table on p. 326), and from the Upper Devonian of St. John, New Brunswick. In New York it was stated to occur "in the base of the Catskill group and in the upper part of the Hamilton group" (p. 313); but in a note opposite p. 329, it is stated that "the plants noticed in this paper as from the Catskill group of New York really belong to a somewhat lower horizon, that of the Chemung group." Dr. Dawson identified the plant figured by Professor H. D. Rogers (Geol. of Penna., vol. ii, pt. II, p. 829, fig. 677), and which he thought was identical with the *Lepidodendron chemungense* (Hall) Dn., from the Chemung group, near Elmira, New York, from the Vergent series of Pennsylvania (Chemung of the New York nomenclature), as belonging to this species. The specimen figured by Vanuxem (Geol. New York, pt. III, p. 157, fig. 38), which came from the Hamilton stage near Unadilla Forks, Otsego County, and other specimens regarded as the same species by Vanuxem, reported from the Hamilton on the Cooperstown and Burlington road, about three miles from Burlington, Otsego County, as well as on the road from Summit to Hinsdale, probably in the Hamilton of Schoharie County, was considered by Dr. Dawson as belonging to this species; also the specimen (op. cit., p. 191, fig. 55) from the Catskill between Bainbridge, Chenango County, and Colesville, Broome County. [The geological age of the last specimen is older than the Catskill and probably near that of the lower Chemung.]

Dawson, Fos. Plants Dev. and Up. Sil. Canada, 1871, p. 33, in a concise specific description of the species, with additional illustrations, pl. viii, figs. 82–84, stated that the plant was rare in the Gaspé sandstones, and that the St. John specimens were of Middle Devonian age.

Carruthers, Quart. Jour. Geol. Soc., vol xxviii, 1872, p. 351, referred Dawson's figures of this species, as well as *Leptophlœum rhombicum* Dn., to *Lepidodendron nothum* Ung. nec Salter. On p. 353 it was stated that "Dr. Dawson's figure leaves no doubt as to the identity of the Canadian and Australian plants, as far as the small fragments found in Canada enable one to come to a positive decision; and the same may be said of Unger's specimen from Germany."

Dawson, ibid., vol. xxix, 1873, p. 369, states that he considers *Lepidodendron gaspianum* and *L. nothum* as specifically distinct, although allied species, but that between *L. nothum* and *Leptophlœum rhombicum* there is not even a generic connection. This opinion was reaffirmed, with additional evidence in its support, by Dawson in 1878 and 1882 (Canadian Nat., vol. viii, pp. 379, 380; Fos. Plants Erian (Dev.) and Up. Sil. Canada, Pt. II, p. 107). In the discussion on Dr. Dawson's note Mr. Carruthers admits that his opinion was based on "published observations and drawings;" and in the same way comparing specimens of *Lepidodendron gaspianum* with figures of *L. nothum* Ung. seems to justify Dr. Dawson's position; while Mr. Kidston says "The plant figured and described as *Lepidodendron nothum* by Mr. Carruthers (which, however, is not Unger's species of that name) appears to be indistinguishable from *Lepidodendron australe* McCoy (Cat. Palæozoic Plants, 1886, p. 231).

Newberry, Rept. Geol. Surv. Ohio, vol. i, Geol. and Pal., Pt. I, Geology, 1873, p. 147, states that a specimen of *Lepidodendron* found in the Corniferous limestone at Sandusky, Ohio, is apparently identical with *L. gaspianum*. Later the Professor figured a specimen from the Corniferous limestone of Delaware, Ohio (Jour. Cin. Soc. Nat. Hist., vol. xii, 1889, p. 56, pl. vi, fig. 2), under the name of *L. gaspianum* Dn., which he stated "is evidently a branch of *Lepidodendron*, and undistinguishable from Sir William Dawson's species. It would, however, be unwarranted to assert that it is the same, since the material for comparison is so meagre; but it is evident that, if not the same, it is a closely allied species."

Fontaine, Am. Jour. Sci., 3d ser., vol. vii, 1874, p. 578, reported this species from the Lewis Tunnel on the Chesapeake and Ohio R. R., near the boundary between Virginia and West Virginia, in what he then called Catskill rocks. but later changed to Vespertine (Pocono). But in his list of the Vespertine flora (2d Geol. Surv. Penna., P², 1880, p. 6) the species is not mentioned, although this locality is stated to yield "the greatest variety of plants" of any of the Vespertine localities.

Crépin, Bull. Soc. Roy. Bot. Belgique, vol. xiv, 1875, p. 218, pl. i–v, identified specimens from the Lower Devonian of Fooz-Wépion, and Rouveroy, Belgium, as *L. gaspianum* Dn. Dawson says " The Lepidodendron from the Devonian of Belgium, described and figured by Crépin . . . . would seem to prove that this species existed in Europe as well as in America (Canadian Nat., vol vii, 1878, p. 380); while Kidston, in commenting on these figures, says "it is evident that pls. iii, iv, and v of *Lepidodendron Gaspianum* Crépin (? not Dawson) are the *Psilophyton Dechenianus* Göppert, sp. As to those specimens which he figures on pls. i and ii I cannot express an opinion, as I have not seen any similar *Lepidodendron*-like fossils . . . . The entire agreement of Crépin's pls. iii, iv, and v with the figures given by Hugh Miller and Mr. Carruthers proves conclusively that all these specimens belong to one species—the *Psilophyton Dechenianus* Gōppert, sp., as interpreted by Mr. Carruthers (Cat. Palæozoic Plants, 1886, p. 234).

Zeiller, Bull. Soc. Géol. de France, 3d ser., vol. viii, 1880, p. 504, mentions a specimen from the Devonian of Caffiers, France, which is compared with *L. gaspianum.*

J. C. White, 2d Geol. Surv. Penna., Q^4, 1881, pp. 65, 78, 79, reported specimens from the Shenango group, sub-Carboniferous, near Jamestown, Crawford County, Penna., which he considered as " *Lepidodendron Gaspianum,* or a closely allied plant ;" also, from the same formation near Townville, Crawford County (op. cit., p. 191). Professor White compares these specimens with the one figured by H. D. Rogers (Geol. Penna., vol. ii, 1858, pl. xxi, fig. 2, and mentioned on p. 830) from the Vespertine sandstone (Pocono) at Mauch Chunk, Penna., which does not seem to agree closely with *L. gaspianum* Dn.

Lesquereux, 2d Geol. Surv. Penna., P, vol. iii, 1884, p. 852, reported the species from the Waverly sandstone (sub-Carboniferous) of Rushville, Ohio, but without any confirmatory evidence.

Dr. J. M. Clarke, Bull. U. S. Geol. Surv., No. 16, 1885, pp. 26, 33, reported the identification of this species by Dr. Dawson from the *Styliola* layer of the Genesee shale of Ontario County, New York; and from the Naples beds (Portage) of Naples, Ontario County (op. cit., p. 64). Also, see Rept. State Geologist [New York] for 1884, 1885, pp. 18, 19, 21, where the same occurrence of the species is mentioned by Dr. Clarke.

White, 2d Geol. Surv. Penna., T^3, 1885, p. 299, reported the species from the Pocono along Shoup's run railroad, Carbon township, Huntingdon County, Penna.

Lesquereux, Proc. U. S. Nat. Mus., vol. ix, 1887, p. 28, identified two specimens from the Pocono of Lewis Tunnel as belonging to this species. Only one of these specimens has been seen; but that appears to belong to a species quite different from *L. gaspianum* Dn.

Finally, the range and distribution of this species may be given concisely as follows: probably from the Corniferous limestone of Ohio; Middle Devonian of Gaspé and New Brunswick; Hamilton, Genesee, Portage, and Chemung (?) of New York; Chemung (?) of Pennsylvania; Upper Devonian of Maine and Gaspé; Pocono possibly of Virginia, and Huntingdon County, Pennsylvania; sub-Carboniferous doubtfully of Ohio and Crawford County, Pennsylvania; possibly in the Lower Devonian of Belgium and Devonian of France.

The writer would acknowledge material assistance from data contained in the species index of the Division of Paleobotany of the U. S. Geological Survey, in compiling the range and distribution of the above species.

It will be seen that there is good evidence for considering the three hundred feet of shales and sandstones included between Cooley's quarry, A^1, of the section, and the Davidson "Coal mine quarry," A^3, as of Devonian age. On account of the fragmentary nature of the fossil plants it is rather hazardous to attempt any close correlation; and yet, after considering the range of the identified species, it may be deemed comparatively safe to consider this part of the section as of Middle Devonian age.

About one-half mile east of the Mountain House, on the opposite side of the ridge, and at about the same altitude as the Davidson "Coal-mine quarry," is the Bull quarry, which has been worked to a considerable extent for flagging-stone. There is very little shale in the quarry, and it is composed mostly of the blue sandstone. The dip is about 17° to the southeast, and no fossils were found.

Southeast of the Bull quarry, and sixty feet higher, or about 1015′ A. T., is a ledge of conglomerate. The pebbles are composed of coarse gray sandstone mixed with white or light-colored quartz, and are rather angular.

Above this conglomerate, and up to the steep point back of the Seven Springs Mountain House, the coarse gray, with some bluish-gray, sandstone appears, alternating with an occasional conglomerate stratum. No red rock was seen in the section. This point is 150′ above the first strong conglomerate ledge, or about 550′ above Monroe.

On the eastern side of Skunnemunk Mountain poorly preserved fossils were found in the second railroad cut, about one-fourth mile north of Woodbury. Most of the rock is the coarse gray sandstone; but near the southern end of the cut is about twelve feet of argillaceous, bluish shale, which is somewhat altered by folding, and this shale contains fossil plants. Most of the specimens are *Psilophyton princeps* Dn.; but in coarse sandstone may be rootlets of *Psilophyton.*

The eastern side of Skunnemunk Mountain, to the west of the railroad, is very steep, the summit of the first ridge being some 600′ above the railroad.[1] The rocks as exposed on this slope consist almost entirely of the coarse gray sandstone, with an occasional conglomerate stratum containing white quartz pebbles. Very little shale was seen and no red rocks. Farther to the west the mountain runs up considerably higher.

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[1] The elevation of the R. R. station is 443′ A. T., according to Mr. Buchholz.

This opportunity is taken to put on record a new locality for fossils in the Hudson shales (?) of Orange County. While waiting for a train at Greycourt some search was made in the exposures of blue argillaceous shale along the N. Y., L. E. and W. R. R. for fossils, but without success. However, in a cut on the Lehigh and Hudson River Railroad, about one-fourth mile southwest of the station, a slightly calcareous layer was found in which fossils were not uncommon. They are more or less distorted by pressure, but the locality is favorable for excavating in search of specimens.

It appears that fossils have been found at only a few places in the Hudson stage of Orange County. Mather mentions two localities at which "a few specimens of testacea" were found "near the villages of Walden and Sugarloaf in Orange County."[1] Sugarloaf is four miles southwest of Greycourt, on the Lehigh and Hudson River Railway, and Walden is in the northern part of the county. Fossils were collected at these localities by Mr. Nelson H. Darton, in 1885, and he added a third locality, Rock Tavern, ten miles west of Newburgh, and intermediate between the other two places. Mr. Darton enumerates eight species from near Sugarloaf village, two from Rock Tavern, and four from near Walden.[2]

These localities are also mentioned by Mr. Darton in a letter entitled "The Taconic Controversy in a Nutshell," published January 22, 1886.[3] The fossils contained in these slates Mr. Darton was inclined to consider as of Trenton age.[4]

Professor Cook stated: "No fossils have been found in the rock [Hudson River slate] in this state [New Jersey], though they are abundant in it in some parts of New York "[5]

Mr. Charles D. Walcott, in a paper on "The Value of the term 'Hudson River Group' in Geologic Nomenclature," states, under the heading of "Discoveries of Recent Years," that "the discovery of fossils other than graptolites in the dark shales or sandstones of the Hudson River group below Albany has been infrequent. Mr. T. Nelson Dale found a few species at Marlborough, about eight miles south of Poughkeepsie, in 1879, and Mr. Nelson H. Darton found a few Trenton-Hudson species twenty-one miles south of Newburgh [Sugarloaf village], in 1885. On the east side of the Hudson, Mr. Dale discovered, in an argillaceous schist near Vassar

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[1] Geol. New York, Pt. I, 1843, p. 369.

[2] Am. Jour. Science, 3d ser., vol. xxx, December, 1885, pp. 453, 454.

[3] Science, vol. vii, pp. 78, 79.

[4] See Macfarlane's Am. Geol. Rail. Guide, 2d edit., 1890, p. 132, f. n. 123; p. 133, f. n. 130, on Greycourt, where Mr. Darton stated that "west of the Oxford limestone to the Blue, or Shawangunk Mountain, at Otisville there is a rolling country underlaid by slates, which have been recently found to be Trenton in age;" also p. 134, f. n. 142, on Craigville, two miles northeast of Greycourt, see the statement that "This series of slates, occupying large areas in Orange County, New York, and extending southward into New Jersey, contains a mixed Hudson River and Trenton limestone fauna, and should perhaps be designated Trenton."

[5] Geol. New Jersey, 1868, p. 135.

College, an assemblage of fossils much like that reported by Mr. Darton in Orange County."[1]

U. S. GEOLOGICAL SURVEY, May, 1892.

The following papers were then read:—

Notes on the Discovery of Chloroform.

BY OLIVER P. HUBBARD.

In a lecture before the Academy March 21, 1892, on the "Contributions of Organic Chemistry to Modern Medicine," it was stated "that Leibig was the discoverer of chloroform." This gave rise to some discussion and to counter-statements that invalidated the claim for Liebig.

It is now at least sixty-one years since chloroform was discovered, and there were three chemists to whom the discovery has been credited by their friends and in support of their own claims, viz:—

Guthrie in America.
Soubeiran in France.
Liebig in Germany.

In this long period the evidence of priority has become somewhat obscured.

As I have had a personal knowledge of the American title to this claim, I have been invited by the Academy to give a narrative of the facts for record in its Transactions, and I respectfully present the following.

In August, 1831, I entered the laboratory of Yale College as Professor Silliman's assistant, and remained five years.

Professor Silliman had received from Dr. Samuel Guthrie, of Sackett's Harbor, N. Y., an ingenious self-taught manufacturing chemist, a box of his numerous products. At the beginning of the chemical course in October I opened the box, which contained chlorate of potash in larger and more beautiful crystals than any I have to this day seen, numerous varieties of percussion, waterproof priming-powder, molasses from potatoes, etc., and several bottles of chloroform distillate in alcohol (chloric ether). I believe I was the first person to repeat Guthrie's process in the course of lecture illustrations in 1831, and before the labors of Soubeiran and Liebig.

In 1887, Mr. O. Guthrie, of Chicago, a grandson of Dr. Guthrie, at the request of the "Jefferson County Historical Society," N. Y., prepared "Memoirs of Dr. Samuel Guthrie and the History of the Discovery of Chloroform," a pamphlet of 35 pages. In this he has given all the documentary history connected with the work of Soubeiran and Liebig, from the French and German journals. He has also collected all the facts and the records in volumes 21 and 22

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[1] Bull. Geol. Soc. Am., vol. I, April, 1890, p. 344.

of the American Journal of Science, included in the correspondence between Dr. Guthrie and the editor, Professor Silliman, and has established beyond all doubt or cavil the right of Dr. Guthrie to the title of "*Discoverer of Chloroform.*"

The following article was also presented:—

CHICAGO, February 6, 1888.

Mr. Chairman and Members of the Chicago Medical Society:—

Your committee appointed to consider the subject of the discovery of chloroform would respectfully submit the following report:—

There are three claimants to the honor of the discovery—Liebig, of Germany, Soubeiran, of France, and Guthrie, of America.

LIEBIG'S CLAIM.—Liebig claims to have published his discovery in November, 1831 (see Liebig's Annalen, vol. 162, page 161).

SOUBEIRAN'S CLAIM.—Soubeiran claims to have published his paper on ether bichlorique in October, 1831, in the Annales de Chimie et de Physique.

Liebig shows (see Liebig's Annalen, volume 162, page 161) that the October number of the Annales de Chimie et de Physique was delayed in its publication, and that it did not appear until January, 1832. It certainly is evident that it was not published in October, as it contains the meteorological report for the entire month of October.

GUTHRIE'S CLAIM.—In the January number, 1832, of Silliman's American Journal of Science and Art, we find an article by Dr. Samuel Guthrie, dated September 12, 1831, in which he says: "A bottle and phial contain alcoholic solution of chloric ether. The contents of the phial are as strong as I could conveniently prepare them, but not equal to some which I made not long ago."

In the October number, 1831, of the same journal (page 64, vol. xxi) we find an article by Dr. Guthrie, without date, upon a "new mode of preparing a spirituous solution of chloric ether," in which he says: "During the last six months a great number of persons have drunk of the solution of chloric ether not only freely but frequently to the point of intoxication."

We find a notice to contributors in Prof. Silliman's journal in which he says: "Communications to be in hand six weeks, or when long, and especially with drawings, two months before the publication day."

Dr. Guthrie's paper on chloric ether must then have been in the hands of the printer in July or August, 1831, and if people had drunk his chloric ether for six months, it would place the date of his discovery in the early part of 1831.

We therefore conclude that Dr. Samuel Guthrie is justly entitled to the honor of first discovering chloroform, and that the publication of his discovery antedates that of either Liebig or Soubeiran.

Respectfully submitted,

F. E. WAXHAM,
N. S. DAVIS, JR.,
E. WYLLYS ANDREWS.

On motion, the report of the Committee was accepted and ordered printed in the Transactions of the Society.

WM. T. BELFIELD,
President.

FRANK BILLINGS,
Secretary.

☞ Silliman's American Journal of Science and Arts was published quarterly, on the first of April and July, and the *first* of October and January. The April and July numbers were bound as one volume, and the October and January numbers as another. O. G.

Historical Notes on the Gold-cure.

BY H. CARRINGTON BOLTON.

Avoiding all discussion of the merits or demerits of the so-called bichloride of gold cure, now so prominent in the public mind, we propose to show that the use of gold as a medicine is not so novel as commonly thought; and by extracts from early writers on chemistry and medicine to indicate the opinions held with respect to alleged "tinctures of gold" at different periods during several centuries.

The precious metal has been employed both externally and internally, in the metallic state, in solution, and by sympathy, for a great variety of the ills that flesh is heir to, for over two thousand years. The train of thought which led the ancients to employ this highly-prized material can be well told in the quaint language of the distinguished Dutch physician and chemist, Herrman Boerhaave; writing about 1725, he says: "The alchemists will have this metal contain I know not what radical balm of life capable of restoring health and continuing it to the longest period." "What led the early physicians to imagine such wonderful virtue in gold was that they perceived certain qualities therein which they fancied must be conveyed thereby into the body; gold for instance is not capable of being destroyed, hence they concluded it must be very proper to preserve animal substances and save them from putrefaction, which is a method of reasoning very much like that of some fanciful physicians who sought for an assuaging remedy in the blood of an ass's ear by reason the ass is a very calm beast." (Shaw's transl. Boerhaave's Chemistry, London, 1727, p. 71.)

Something of this sympathetical and mental effect was evidently sought to be attained in the very first instance of the administration of gold recorded in history: "And Moses took the [golden] calf which they had made, and burnt it with fire, and ground it to powder, and strewed it upon the water, and made the children of Israel drink of it." (Exodus, xxxii, 20.)

Pliny in his marvellous compilation "Natural History," written about 70 A. D., has a paragraph on the "medicinable virtues of gold," which in "divers waies is effectuall in the cure of many diseases. For first of all sovereign it is for green wounds, if it be outwardly applied." Pliny describes a form of liniment of gold "torrefied" with salt and schistis which "healeth the foule tettar that appeareth in the face," fistulas, etc And he alludes to a preparation of gold in honey which "doth gently loose the belly if the navel be anointed therewith." And in conclusion Pliny quotes Marcus Varro, who "saith that gold wil cause warts to fal off. (Holland's translation.)

Varro was a friend of Cicero, which carries back this belief in the efficacy of gold to the first century before Christ.

The Arabian physicians, who for hundred of years possessed almost exclusive knowledge of chemistry, often record the virtues of gold as a remedial agent in disease. Geber, who lived in the eighth century, wrote: "Gold is a medicine rejoycing and conserving the Body in Youth." (Russell's transl., London, 1678, p. 76.) Avicenna is said to have written in its praise; also Arnold de Villanova (1235–1312).

The preparation of gold in a potable innocuous form occupied the attention of the alchemists during several centuries; they commonly called it *aurum potabile,* and ascribed to it not only remedial virtues, but the power of prolonging life. The quotation from Geber shows he shared this opinion.

To this elixir of life they gave many fanciful names; Elias Ashmole, in his "Theatrum Chemicum Britannicum," says Saint Dunstan calls it the "Food of Angels," and others the "Heavenly Viaticum." Ashmole himself adds: "It is undoubtedly the true Alchochodon or giver of years, for by it man's body is preserved from corruption, being thereby enabled to live a long time without food; nay, 'tis made a question whether any man can die that uses it." (Written in 1652.)

The alchemists argued that this golden elixir is not to be made of vulgar gold, but only from philosophical gold prepared by hermetic art. Recipes for manufacturing this panacea abound in alchemical works; they are mostly very tedious, requiring endless repetitions and much faith on the part of the operator. One of the simplest methods of preparing aurum potabile is given by Samuel Bolton in his curious little 16mo. "Medicina magica tamen physica," published at London in 1650. "Put foliated gold into a vessel well sealed with Hermes' seal; put it into our fire till it be calcined to ashes; then sublime it into *flores,* having his *caput mortuum* or black *terra damnata* in the bottom. Then let that which is sublimed be with the same degree of fire united to the same *caput mortuum* that it may be revived by it, so that all may be reduced into an Oyle, which is called *Oleum Solis.* The dose hereof is two or three grains."

This description leaves much to the imagination, and in this respect differs little from others that we might quote. To non-chemists, we may add that few of the recipes yield a product containing gold, the metal often remaining in the part thrown away.

Roger Bacon, the Franciscan Friar of the 13th century, to whom so many wonderful discoveries and inventions have been ascribed, had deep faith in the virtues of potable gold. Bacon in a communication to Pope Nicholas IV, informs his Holiness of an old man who found some yellow liquor in a golden flask when ploughing one day in Sicily. Supposing it to be dew he drank it off, and was immediately transformed into a hale, robust, and highly-accomplished youth. Having abandoned his day-laboring, he was admitted to the service of the King of Sicily and served the court eighty years.

The belief in a life-prolonging elixir, sometimes claimed of the tincture of gold and sometimes of secret preparations, prevailed for centuries. Even so great a philosopher as Descartes believed he had attained the art of living a few hundred years; this belief was shared by some of his friends, and when he died before reaching sixty years they were convinced that he had been poisoned.

Raymond Lully, a contemporary of Friar Bacon, also experienced the restorative effect of this fountain of youth, if we can trust the statement in the curious verses of Sir George Ripley, composed in 1471.

"An Oyle is drawne owte in colour of Gold,
Or lyke thereto out of our fire Red Lead,
Whych *Raymond* sayd when he was old
Much more than Gold wold stand hym instede;
For when he was for age nygh dede,
He made thereof *Aurum Potabile*
Whych hym revyvyd as men myght see".
(Compound of Alchymie.)

Oswald Croll, a German physician of the 16th century, wrote in 1609 in praise of gold as a medicine. I quote the English translation of his Basilica chymica published at London in 1670.

"It is the principal part of a Physician that would Cure the Sick, first to comfort the Heart, and afterwards assault the Disease. Those to whom the harmonious Analogy of Superiours and Inferiours hath been known, and who from suffrages of Astrologers have learned that to the two greatest Lights of Heaven, the two principal parts of Man, viz., the Heart and Brain, in things of Nature latently rests in GOLD. . . . . For Nature hath endowed Gold with no contemptible virtues, which who so knows how to draw out, and by ingenious Artifice is able rightly to use, he will find Gold, which seemed dead and barren, so lively and pregnant that it germinates and of itself progenerates new Gold. . . . . Whence the true Philosophers have exquisitely prepared a wonderful and greatly to be desired Medicine with which the impurities of imperfect Metals are removed and all vices of affects in uncurable Diseases of Humane Bodies, perfectly exterminated." . . . .

Croll then says he has tried almost one hundred different preparations of aurum potabile, and condemns most of them to recommend his own, which is fulminating gold, called by him "Calx of Sol." His process embraces nauseous ingredients, and the product is free from gold.

Paracelsus, the physician who did so much to improve materia medica by introducing chemical medicines, does not neglect gold. Thurneisser, his disciple (both as respects his teachings and his charlatanism), made his royal dupes pay enormous sums for the "tincture of gold" which entered into his extraordinary prescriptions.

To the use of Royal Touch Pieces (gold coins) in the reigns of Charles II., James II., and Queen Anne, mere allusion should be made.

Christopher Glaser (1663) gives amongst other preparations a "diaphoretic powder of gold," and prescribes it for continuous or intermittent fevers, the dose being four to twelve grains in wine, or in a spoonful of bouillon. (Traité de la chymie, Paris, 1663.)

Antoine Lecoq (or Gallus), a physician of Paris (1540), seems to have been the first to recommend gold for syphilis. He and his follower, Fallopius (of Modena, 1565), describe tedious processes for making preparations of gold. These processes were carefully repeated about the beginning of this century by Chevallier, a French pharmacist, who declares the products contain no gold at all.

Lamotte's "gold-drops," celebrated throughout Europe for fifty years (1725–1780), consisted of a solution of ferric chloride in alcohol; this possessed a yellow color, and was universally regarded as a preparation of gold until the secret was bought and made public by the Russian government. (Kopp's Geschichte.)

Frederic Hoffmann, a famous German physician (1733), recommends gold for rheumatic fever.

Johann Rudolph Glauber, the German physician whose name is indelibly attached to certain "salts," thought to improve the latter by adding gold. . . . "In all diseases and infirmities of what name soever the Spirit or Oil of Salt in which gold is rightly dissolved (or the Aurum Potabile made with it), giveth present help, and in all dejections of the vital spirit . . . it giveth such relief that life and vigor may be somewhat farther protracted if two, three, or four drops be administered as occasion shall serve in good Aqua Vitæ or Cordiall Water. In like manner if three drops be administered once a week in generous wine or aqua vitæ, or other fit vehicle, it renovateth a man, makes him youthful, changeth gray hairs, produceth new nails and skin, preserveth from various and diverse symptoms of diseases, and preserveth the body in such a state even to the prefixed hour of the Divine appointment." This is quoted by Glauber from Conrad Khunrath, in his "Medulla Distillatoria:" . . . "I some time since administered this oil of gold for eight or ten days successively to an infant for the freeing his body from mercury." . . . (Glauber's Works, Packe's transl., London, 1869.)

Robert Boyle, in his Usefulness of Natural Experimental Philosophy (1663), expresses doubts as to the "strange excellency" of aurum potabile, remarking that "learned physicians and chymists have pronounced the preparation of potable gold as itself unfeasible." And he adds: "I should much doubt whether such a potable gold would have the prodigious vertues its encomiasts ascribe to it and expect from it; for I finde not that those I have yet met with deliver these strange things upon particular experiments duly made, but partly upon the authority of chymicall books, many of which were never written by those whose name they bear." He then proceeds to blame physicians for using expensive medicines, and says "'t were a good work to substitute cheap ones for the poorer sort of patients."

The change of opinion as respects the therapeutic value of gold, foreshadowed in the quotation from the astute Boyle, is well shown by comparing the passages on the subject in two different editions of Lémery's "Cours de chymie," one published in 1680 and one in 1730. In the earlier edition of Lémery's very successful work we read:—

"Gold is a good remedy for those that have taken too much mercury, for these two metals do easily unite together, and by this union or amalgamation the mercury fixes and its motion is interrupted. (p. 25) . . . . Aurum fulminans causes sweat and drives out ill humors by transpiration. It may be given in the small pox two to six grains in a lozenge or electuary. Its stops vomiting and is also good to moderate the active motion of mercury." (Harris's translation, London, 1680, p. 9.)

And in the later edition, the eleventh of the series, Lémery, or his editor, makes a very different statement.

"Potable gold, so much praised by the alchemists and sold so dear by them, is commonly only a vegetable or mineral tincture of a color resembling gold, and as they make this tincture with a spirituous menstruum it sometimes excites perspiration. This effect they ascribe to the gold, although the metal has rarely anything to do with it." (1730.)

In the works of Dr. Caspar Neumann a passage occurs that expresses so clearly the present views of many, that it is hard to realize it was written nearly one hundred and fifty years ago. Neumann writes:—

"Gold has been imagined to be possessed of extraordinary medicinal virtues, and many preparations, diginified with the name of this precious metal, have been imposed upon the public. But the virtues ascribed to gold have apparently no other foundation than credulity and superstition, and most of the golden medicines have no gold in them. Even when gold has been employed in the preparation there is seldom any of it retained in the product. We may say with Ludovici: 'It is better to make gold out of medicines than medicines out of gold.'" (Lewis's transl., London, 1759, p. 38.)

An abstract of the report of the Joy Memorial Committee was read by Prof. MARTIN; the full report will be presented in October.

Dr. BOLTON announced the death of Prof. A. W. VON HOFFMAN, the distinguished chemist, an Honorary Member of the Academy.

Prof. REES announced the death of Dr. L. M. RUTHERFURD, the distinguished astronomer, a member of the Academy, and made some brief remarks on his lifework.

Prof. REES was appointed a committee of one to draw up suitable resolutions for presentation to the Academy.

Meeting adjourned to first Monday in October.

The following papers received too late for publication in their proper places are printed at the close of this volume.

The Railway Problem in China.

BY JOHN A. CHURCH, E. M.

(Abstract.)

Mr. CHURCH stated that there were but two roads in operation in China, one of small account on the Island of Formosa, and one at Tientsin, about 80 miles in length, built to transport coal from the mines to the coast. The history of the building of this road, its gradual extension from a short line, seven miles long, operated by mule-power, to a full-fledged railway, is very interesting. Some idea of its usefulness may be gained from the fact of its having carried 2,000,000 passengers since 1888, when it was completed. This line now carries 1500 passengers daily, 900 tons coal, 100 tons general freight, and 250 tons stone, lime, etc., most of which is used in extending the road. This extension will take the road to Yung Ping, a city on Lan River, and ultimately to Shan Hai Kwan, the seaboard fortress at the end of the Great Wall. The capital value is now about 2,000,000 ta. of about $1.13 each.

There are several reasons for the opposition to railways in China.

1st. A fear that the lines may be used by invaders in penetrating the country in case of war; for that reason it is forbidden to construct roads along the coast, or penetrating the interior.

2d. A settled policy that all roads built must be constructed by the Chinese from materials produced in China, and the roads must be controlled by their own people.

Lastly, the superstition of the people that the burial places of their ancestors will be desecrated by the operation of these roads.

There is no doubt that such a radical change in the means of transportation would temporarily disturb the existing channels of employment for thousands of people.

The question of home production of railway steel, for the Chinese will have none but the best materials, seems to be insurmountable, for the sources of iron and coal are remote from the coast, in places inaccessible without railroads, or are not convenient to each other, or those deposits easily reached are unsuited for steel-making.

Mr. Church stated that the production of iron in China amounted to 500,000 tons per annum, a fact unknown to the world at large.

The Natural Dyes as Applied to Wool.

BY H. T. VULTÉ AND D. W. WARD.

The work described in this brief memoir was undertaken some five years ago, and from causes unseen at that time the publication has been delayed until the present.

As originally designed, the work was merely the preparation of a large series of samples of wool dyed with various natural dyestuffs and common mordants as an exhibit of this branch of the dyer's art now rapidly going out of use.

During the prosecution of the work it was seen that a valuable comparative method of testing these dyes might be evolved from the facts as recorded in the results of these tests.

The samples were prepared from pieces of woollen flannel of known purity weighing ten grams each, washed, mordanted in the proper baths, washed again, and dyed in a bath of the dye carefully prepared, the conditions differing with the various dyestuffs.

225 samples were made, with 5 mordants, the list including the following dyestuffs:—

Brazil-wood,
Peach-wood,
Lima-wood,
Bar-wood,
Sapan-wood,
Cam-wood,
Hypernic,
Cudbear,
Cochineal,
Madder,
Anatto,
Lac,
Catechu,
Quercitron,
Barberry root,
Sumach,
Saffron,
Weld,
Fustic,
Turmeric,
Persian berries,
Logwood,
Tannin.

The method proposed for testing or valuation of a dyestuff is briefly as follows:—

For instance, logwood: Ten grams of flannel are mordanted with alumina sulphate for one hour at 212° F., then cooled, washed, and divided in two equal parts; one part is dyed in a 10 per cent. bath of standard chips for one hour at 212° F. and the other part in a 10 per cent. bath of the logwood to be tested under the same conditions. The two pieces are finally removed from their respective baths, dried, and compared as to shade. It is well to have a few samples of 1, 2½, and 5 per cent. standard dye for comparison. With a little practice the shade may easily be matched within 1 per cent. It is best always to choose the brilliant shades for comparison. I have had no difficulty in keeping standard samples, provided they are protected from strong sunlight.

The following formulæ used in these tests will be found interesting. The figures are always based on the 10 gram swatch of wool:—

BRAZIL-WOOD.

No. 1 (10106, 10107 R, 10108 R).

Wood	5.0 gms.
Alum	0.4 gm.
$K_2C_2O_4$	0.2 "

$1\frac{1}{2}$ hours at 100° C.

Bluish-red.—No. 10106.

Mordant $Al_2(SO_4)_3$	0.4 gm.
$K_2C_2O_4$	0.2 "

Boil 1–$1\frac{1}{2}$ hours, wash, dye in separate bath $\frac{1}{2}$–1 hour at 80°–100° C. 5.0 gms. dye-wood; add to dye-bath 0.6–1.2 gms. $CaCO_3$, also solution of glue. (See Lima-wood.)

Peach-wood same.

No. 2 (10112) K_2Cr_2O.

$K_2Cr_2O_7$	0.3 gm.

Boil for $1\frac{1}{2}$ hours; take out, wash, and boil in the dye-bath

Wood	5.00 gms.

for 1 hour.

No. 1 (10110) $FeSO_4$.

Boil in a bath of the

Wood	5.00 gms.

for 1 hour, then "sadden" in a bath of

$FeSO_4$	0.500 gm.

Boil for $\frac{1}{2}$ hour.

No. 2 (10111) $CuSO_4$.

Same as above, but use $CuSO_4$ instead of Iron.

$CuSO_4$	0.8000 gm.

No. 3 (10109) $SnCl_2$.

Boil in the mordant for 1 hour.

$SnCl_2$	0.100 gm.
Tartar	1.600 gms.

Take out, wash, and dye

Wood	5.00 gms.

Boil for 1 hour.

HYPERNIC.

Stannic tin.

$SnCl_4$ (10030)	0.4 gm.
Tartar (10031)	3.0 gms.
HCl (10047)	3.0 "
Water, dist.	1.5 liters.

Boil for 1½ hours; take out, wash, and dye in a bath of

Wood	7.0 gms.
Water, dist.	1.5 litres.

Boil for 1 hour with frequent agitation; take out and wash.
Red-wood same way, but use 8.0 gms. of wood.

No. 10162.
Boil in a bath of

Wood	6.000 gms.

for 1 hour, then wash and sadden in the alumina bath

$Al_2(SO_4)_3$	1.000 gms.

Boil for 1 hour.

No. 10161.
Boil in $CuSO_4$ for 1½ hours

$CuSO_4$	0.800 gm.

Take out, wash, and dye in a separate bath

Wood	6.00 gms.

Boil for 1½ hours.

PEACH-WOOD.

No. 1 (10150, 10151) $K_2Cr_2O_7$.

$K_2Cr_2O_7$	0.300 gm.

Boil for 1½ hours; take out, wash, and dye in a separate bath

Wood	4.000 gms.

No. 2. Same as No. 1, using

Wood	6.000 gms.

No. 1. $Al_2(SO_4)_3$.

$Al_2(SO_4)_3$	0.400 gm.
$K_2C_2O_4$	0.200 “

Boil 1½ hours; take out and wash; dye in a separate bath

Wood	4.000 gms.

No. 2. Same as No. 1, using

Wood	6.000 gms.

No. 10155, 10156, 10157, Al, Sn, and Tartar.

$Al_2(SO_4)_3$	0.600 gm.
$SnCl_2$	0.100 “
Tartar	0.500 “

(1) 40 per cent. of wood.
(2) 60 “ “ “
(3) 20 “ “ “

No. 3 (10155) Al.
Boil in a bath of

Wood	6.000 gms.
Chalk	0.600 gm.

for one hour; take out, wash, and sadden in a bath of

$Al_2(SO_4)_3$	0.600	gm.
Tartar	0.500	"

Boil for ½–¾ hour.

No. 4 (10154) $SnCl_2$.

Boil in a bath of

$SnCl_2$	0.200	gm.
Tartar	0.500	"
(HCl)	q. s.	

for 1½ hours; take out, wash, and dye in a bath of

Wood	6.00	gms.

Boil for 1 hour. Use distilled water.

No. 1 (10153) $FeSO_4$.

Boil with

Wood	6.00	gms.
$CaCO_3$	0.800	gm.

for 1 hour; take out, wash, and sadden with

$FeSO_4$	0.500	gm.
Tartar	0.800	"

Boil for ½ hour.

No. 2. $CuSO_4$.

Boil with

Wood	6.000	gms.
Chalk	0.800	gm.

for 1 hour; take out, wash, and sadden in a bath of

$CuSO_4$	0.800	gm.

Boil for ½ hour.

REDWOOD.

No. 1.

$K_2Cr_2O_7$	0.200	gm.

Boil for 1½ hours, and dye in a separate bath

Wood	4.0-8.0	gms.

No. 2 (10115) Alumina.

Boil the wool first with 2.0–8.0 gms. of the wood for 1 to 1½ hours; then boil in a separate bath of

$Al_2(SO_4)_3$	0.100	gm.

BAR-WOOD.

No. 1 (10113) $SnCl_2$.

$SnCl_2$	0.100	gm.
Tartar	1.6	gms.
(HCl)	q. s.	

Boil for 1½ hours; take out, wash, and dye in a separate bath

Wood	8.00	gms.

Boil for 1 hour. Use distilled water.

No. 2 (10114) $CuSO_4$.
Boil with wood for 1 hour

Wood	8.00 gms.

then sadden in a bath of

$CuSO_4$	0.800 gm.

Boil for ½ hour.

No. 3. Same as No 2, but sadden with

$FeSO_4$	0.500 gm.

No. 4.

$SnCl_4$ 1.6°	0.4–0.6
Tartar	4.0–16.00 gms.

Mordant 1½–2 hours; wash and boil 1–2 hours. 4.0–8.0 gms. wood.

Bar-wood = Crimson.
Cam-wood = Purplish-red.
Sanders-wood = Yellow-red.

Stuffing and Saddening.—Boil with

Wood	8.0 gms.
Water, dist.	1.5 liters

for 1 hour; take out, wash, and sadden in a bath of

$SnCl_2$	0.4 gm.
HCl	2.0 cc.
Water, dist.	1.5 liters.

Boil ¾ hour; take out and wash thoroughly.

NIC-WOOD.

No. 1. $K_2Cr_2O_7$.
Boil with

$K_2Cr_2O_7$	0.300 gm.

for 1½ hours; take out, wash, and dye in a bath of

Wood	5.000 gms.

Boil for 1 hour.

No. 2. $FeSO_4$.
Boil with the wood first

Wood	5.000 gms.

for 1 hour; take out, wash, and sadden with a bath of

$FeSO_4$	0.400 gm.

Boil for ¾ hour.

No. 3. $CuSO_4$.
Same as No. 2, only sadden with

$CuSO_4$	0.400 gm.

Boil for ¾ hour.

No. 4. $SnCl_2$.

Boil in a bath of

$SnCl_2$	0.2000	gm.
Tartar	0.4000	"
HCl	q. s.	

for 1½ hours; take out, wash, and boil in a bath of

Wood	5.000	gms.

for 1 hour. Use distilled water.

No 5. $Al_2(SO_4)_3$.

Boil in the mordant for 1½ hours

$Al_2(SO_4)_3$	0.600	gm.
Tartar	0.500	"

Take out, wash, and boil for 1 hour.

Wood	5.000	gms.

LIMA-WOOD.

No. 10142, 10148.

Wood	5.00	gms.

Boil for 1 hour; then take out, wash, and sadden with

$CuSO_4$	0.800	gm.

Boil for 1½ hours.

No. 10141.

Wood	5.00	gms.

Boil for 1 hour; take out and sadden in a bath of

$FeSO_4$	0.500	gm.

Boil for 1 hour.

No. 1.

Dye-wood	5.00	gms.
$Al_2(SO_4)_3$	0.400	gm.
$K_2C_2O_4$	0.200	"

1½ hours, 100° C.

Purplish slate.—No. 2 (10143, 10144, 10149) 0.3 gm. $K_2Cr_2O_7$. Wash and dye in a separate bath

Dye-wood	1.00	gm.

Brown.—No. 3.

Dye-wood.	5.00	gms.
Chalk.	0.2	gm.

3–5 per cent. Chalk makes shade bluer.

Bluish-red.—No. 4 (10140).

$Al_2(SO_4)_3$	0.6	gm.
Cream Tart.	0.5	"
Chalk	0.5	"

Wash and dye in separate bath ½–1 hour 80°–100° 4.0–60 gms. dye-wood; add 2–6 per cent. Chalk. Brighter reds by adding to mordanting bath 1 per cent. $SnCl_2$ and same amount old Fustic.

Cam-wood.

Claret-brown.—No. 1 (10120), 40 per cent. No. 2 (10121), 80 per cent.

0.5–2.0 gm. $K_2Cr_2O_7$ dye in separate bath 4.0–8.0 gms. dye-wood; or,

Boil wool 1–2 hours in bath of 4.0–8.0 gms. of dye-wood, to a very full brownish-red color; then in same, or, better, separate bath of 0.2 gm. $K_2Cr_2O_7$ ½ hour.

Pink.—No. 3 (10122) 10 per cent. No. 4 (10123), 40 per cent. No. 5 (10124), 80 per cent.

Boil with 1.0 gm. wood 1–2 hours and dye in 1.0 gm. $Al_2(SO_4)_3$ in separate bath.

40 per cent., red; 80 per cent., deep red.

No. 1 (10125) $SnCl_2$.

$SnCl_2$	0.100 gm.
Tartar	1.000 "
(HCl)	q. s.

Boil for 1½ hours; take out, wash, and dye in a separate bath

Wood	5.00 gms.

Boil for 1 hour. Use distilled water.

No. 2 (10125) $CuSO_4$.

Boil in a bath of the wood for 1 hour.

Wood	5.000 gms.
$CaCO_3$	0.100 gm.

Take out, wash, and sadden with

$CuSO_4$	0.800 "

Boil for ½ hour.

No. 3. $FeSO_4$.

The same as No. 2, but use $FeSO_4$ . . . 0.500 gm.

Sapan-wood.

No. 10135, 10136. Sn.

$SnCl_2$	0.100 gm.
Tartar	1.600 gms.

Boil for 1½ hours; take out, wash, and dye in a bath of

Wood	5.00 gms.

No lime-salts must be present. Use distilled water.

No. 10138.

$CuSO_4$	0.800 gm.

Boil for 1½ hours; take out, wash, and dye in a bath of

Wood	5.000 gms.
Chalk	0.800 gm.

Boil for 1 hour.

NOTE.—To mordant wool efficiently with Aluminium Sulph., prepare the following solution:—

H_2O	1000.00 gms.
$Al_2(SO_4)_3$	8.00 "
Tartar	7.00 "

Immerse the wool in the cold solution; raise the temperature gradually to the boiling-point in the course of 1–1½ hours; continue boiling ½ hour longer, then wash well.

COCHINEAL.

Reddish-purple.—No. 1 (10065).

$CuSO_4$	1.00 gm.

Boil ¾ hour; take out and wash well.

Cochineal	1.2 gms.

in separate bath. Boil 1 hour.

Purplish slate.—No. 2 (10061).

$FeSO_4$	0.8 gm.
Tartar	2.00 gms.

Boil ¾ hour; take out, wash, dye in separate bath for 1 hour at 100° C.

Cochineal	1.2 gms.

Purple.—No. 3 (10064).

$FeSO_4$	0.4 gm.
$K_2C_2O_4$	0.4 "
Cochineal	1.2 gms.

Enter flannel at 50° C.; raise to boil; boil 1 hour.

Cochineal Spirits.—No. 1 (10050).

HCl	100 gms.
Sn	12½ "
Cochineal	1.0 gm.
Tartar	0.5 "
Spirits	1.5 gms.

Boil 20 minutes, cool down; enter wool, boil 1 hour; soak over night.

No. 10051. Same, using 0.5 dye, 0.3 Tartar, 0.8 cc. Spirits.

No. 10052. Same, using 0.1 dye, 0.1 Tartar, 0.2 cc. Spirits.

No. 2 (10061, 10062).

$FeSO_4$	0.8 gm.
Tartar	0.2 "

Boil $\frac{3}{4}$ hour; take out, wash, and dye in separate bath for 1 hour

Cochineal	1.2 gms.

Cochineal crimson.

$Al_2(SO_4)_3$	0.4 gm.
Tartar	0.5 "

Mordant; wash and dye 1–1$\frac{1}{2}$ hours

Cochineal	0.8 "

Scarlet.—No. 1.

Mordant 1–1$\frac{1}{2}$ hours with 0.6 gm. $SnCl_2$, 0.4 gm. Tartar; wash, and dye in 0.5 gm. Cochineal 1–1$\frac{1}{4}$ hours; enter wool in mordanting and dye-baths at 50° C. and raise gradually to boiling.

No. 2.

Bath $\frac{1}{2}$ full of water.

$H_2C_2O_4$	0.6 gm.
$SnCl_2$	0.6 "
Cochineal.	0.5 "

Boil 5–10 minutes; fill bath with cold H_2O; introduce wool; heat to boiling $\frac{3}{4}$–1 hour; boil $\frac{1}{2}$ hour.

Use $SnCl_2$ in solution. A moderate amount of HCl is advantageous.

Cochineal Spirits.—No. 10050.

Cochineal (10014)	1.000 gm.
Tin Spirits (10040)	0.100 "
Water, dist.	1.5 liters.

Mix the Cochineal (ground) with water to a thin paste; add Tin Spirits, dilute with water, heat to boiling, and continue 15 minutes; then cool to 180° F., enter wool, raise to boiling, and continue for 1 hour, or until the bath is exhausted; allow to cool in the bath, then take out and wash in warm water.

No. 10059, 10060.

Cochineal with $K_2Cr_2O_7$ 0.2 gm. and 0.3 gm. H_2SO_4 conc. gives purple.

Cochineal crimson.—No. 1 (10053).

$Al_3(SO_4)_3$	0.4 gm.
Tartar.	0.5 "

Boil 1–1$\frac{1}{2}$ hours.

No. 2.

Cochineal	8.0–15.0 gms.

Cochineal scarlet.—No. 2 (10054, 10055).

First method: Mordant 1–1½ hours with 0.6 gm. $SnCl_2$ cryst., 0.4 Tartar; wash, and dye in 1.2 gms. Cochineal 1–1¼ hours; enter wool in mordanting and dye-baths at 50° C. and raise gradually to boiling.

No. 3 (10056).

Second method: Bath ½ full of water

Oxalic Acid	0.8 gm.
$SnCl_2$	0.6 "
Ground Cochineal.	1.2 gms.

Boil for 5–10 minutes; then fill bath with cold water, introduce wool, heat to boiling-point (¾–1 hour), and boil ½ hour. Bath not exhausted in this method.

Deficiency of tin causes dull bluish-red; an excess makes the scarlet paler.

LAC.

Dye	1.00 gm.
$SnCl_2$	0.600 "
HCl	q. s.
Oxalic Acid	0.600 gm.

Boil 1½ hours. Add the HCl to the dye and allow to stand over night.

Chromium.

$K_2Cr_2O_7$	0.3 gm.

Same amount of Lac as above. Mordant; wash, and dye in separate bath 1½ hours.

Alumina.

$Al_2(SO_4)$	0.4 gm.
Tartar	0.5 "

Mordant; wash, and dye.

Copper.

$CuSO_4$	1.0 gm.

Iron.

$FeSO_4$	0.8 gm.
Tartar	2.0 gms.

Scarlet Lac Spirits.

Solution—

HNO_3	20 gms.
HCl	10 “
H_2O	20 “
Sn	6 “
Lac	1.5 “
Tartar	0.5 gm.
Spirits	1.5 gms.

Boil 20 minutes, cool down; enter wool, boil 1 hour; soak over night.

No. 2 (10068, 10069).

Dye	1.5 gms.
$SnCl_2$	0.6 gm.
Oxalic Acid	0.6 “
HCl	q. s.

Boil 1½ hours. Enter wool cold; raise to boil slowly.

Note well.—Add HCl, 4 or 5 drops, to about 25 cc. H_2O; rub this up with the dye and allow to stand over night.

MADDER.

Red.—No. 1 (10077).

Mordant first—

$Al_2(SO_4)_3$	0.6–1 0 gm.
Tartar	0.5–0.8 “
Madder	6.0–8.0 gms.

Begin dyeing at 40° C.; raise to 80°–100° C. during 1 hour, continue 1 hour, wash, and dry.

The shade is brownish-red, brightened by adding small amount $SnCl_2$ to dye-bath at close of operation; better colors, 1–2 per cent. weight of Madder in Chalk.

The best results are obtained at 80° C.; add 0.6 gm. Sumach to bring out color.

Orange.—No. 2 (separate bath).

$SnCl_2$	0.8 gm.
Tartar	0.4 “
Madder	6.0 gms.

No. 2 *a*. Same (single bath).

$SnCl_2$	0.4 gm.
$H_2C_4H_4O_6$	0.2 “

Brown.

$CuSO_4$	0.6 gm.
Tartar	0.4 “

Mordant and dye.

Dark brown.

$FeSO_4$	0.8 gm.
Tartar	0.3 "

Mordant and dye.

Reddish-brown.—No. 10077.

$K_2Cr_2O_7$	0.3 gm.

Mordant; wash, and dye in separate bath of

Madder	6.0 gms.

No. 10076.

Dye with Madder alone at 80°C., using

Madder	6.00 gms.

In the second batch no Sumach was used; all samples were treated in a bran-bath for 5 minutes at 70° C. to brighten and fix; used distilled water and Chalk.

Orchil (Cudbear).

Neutral bath.
Acid bath with H_2SO_4.
Alkaline bath with soap solution.

Anatto.

Dye at 50° C., with soap for pale shades.
Dye at 80°–100° C., without addition, for dark shades.

No. 1 (10233).

Dye	2.00 gms.

Add soap; dye at 50° C. (use soap solution).

No. 2 (10234).

Dye	4.00 gms.

Same as above.

No. 3 (10235).

Dye	6.00 gms.

No soap.

No. 4 (10236).

Dye	8.00 gms.

No soap.

Weld.

Old gold.—No. 1 (10248).

$K_2Cr_2O_7$	0.2 gm.

Mordant; wash, and dye in separate bath

Weld	6.0 gms.
Chalk	0.3 gm.

No. 2 (10250).

$Al_2(SO_4)_3$	0.4 gm.

Mordant; wash, and dye in separate bath with

Weld	7.5 gms.

1 hour at 80°–90° C.

No. 3.

$SnCl_2$	0.8 gm.

Mordant; wash, and dye in separate bath

Weld	7.5 gms.

No. 4 (10249).
Same, with

$CuSO_4$	0.6 gm.
Chalk	0.8 "

No. 5.
Same, with

$FeSO_4$	0.4 gm.
Tartar	0.3 "

Old Gold.

$K_2Cr_2O_7$	0.2 gm.

Mordant and dye in separate bath with 0.6 gm. Weld; add 3.0 gms. Chalk to dye-bath.

Yellow.—Mordant 1–2 hours with 0.4 gm. $Al_2(SO_4)_3$; wash, and dye in separate bath with decoction of 5.0–10.00 gms. Weld for 20–60 minutes at 80°–90° C.

Prepare bath just before dyeing; chop the Weld, put in bags, and boil in soft water ½–1 hour; add 0.4 gm. Chalk before dyeing.

Brighter yellows are obtained by mordanting with 0.8 gm. $SnCl_2$.

Also, single bath similar to cochineal scarlet gives bright yellows.

Yellowish-olive.—Mordant with 0.6 gm. $CuSO_4$; add 0.2–0.8 gm. $CaCO_3$ or 0.4 gm. $FeSO_4$ and 0.3 gm. Tartar, with Chalk.

FUSTIC.

Use water-bath.

No. 1 (10169, 10170).

$K_2Cr_2O_7$	0.4 gm.

Boil 1–1½ hours; dye in separate bath at 100° C., 20–80 per cent. Wood.

This will yield a brownish or olive-yellow.

Yellow.—No. 2 (10171, 10172) (single bath).

$Al_2(SO_4)_3$	0.4 gm.
$H_2C_2O_4$	0.2 “
Wood	2–4 gms.

Dye 1–1½ hours at 80°–100° C.

The addition of Tartar deepens, but dulls the color.

Yellow.—No. 3 (10173, 10174, 10175).

$Al_2(SO_4)_3$	0.8 gm.

Mordant 1–1½ hours at 100° C. and wash; dye-bath, 2–4 gms. Wood; work in this for ½–¾ hour at 80°–90° C.

By using 0.2–0.3 gm. $SnCl_2$ crystals with the alum, much brighter colors can be obtained. (See No. 4.)

Yellow.—No. 4 (10176, 10177, 10178).

$Al_2(SO_4)_3$	0.8 gm.
$SnCl_2$	0.3 “

Enter into bath at 50° C., heat gradually to 100° for 1–1½ hours, and dye as in No. 3.

Yellow.—No. 5 (10179, 10180).

$SnCl_2$	0.8 gm.
Tartar	0.8 “

Treat 1–1½ hours at 100° C., wash, and dye in a bath of

Wood	3–4 gms.

treating 30–40 minutes at 80°–100° C.

Yellow.—No. 6 (10181) (single bath).

Wood	4.00 gms.
$SnCl_2$	0.8 gm.
Tartar	0.4 “
Oxalic Acid	0.2 “

Avoid prolonged dyeing, especially at 100° C., as the tannin injures the colors; to avoid this trouble use solution of glue to extent of 4–8 per cent. of the dye-wood.

Olives.—No. 7 (10182) (single bath).

$CuSO_4$	0.6 gm.
Tartar	0.4 “
Wood	4.0 “

Or omit Tartar.

No. 8 (10183).

Mordant and dye, using same bath.

No. 9 (10184, 10185).

$FeSO_4$	0.8 gm.
Tartar	0.3 “

Mordant and dye.

No. 10 (10186, 10187) (single bath).
Use no Tartar.

Brownish or olive-yellow.—No. 1.

$K_2Cr_2O_7$	0.400 gm.

Boil 1–1½ hours and dye in separate bath 1–1½ hours at 100° C., 2.0–8.0 gms. dye.

Yellow.—No. 2 (single bath).
1–1½ hours at 80°–100° C.

$Al_2(SO_4)_3$	0.4 gm.
$H_2C_2O_4$	0.2 "
Wood	2.0–4.0 gms.

The addition of Tartar deepens, but dulls color.

No. 3.
Mordant 1–1½ hours with 0.8 gm. $Al_2(SO_4)_3$, wash, and dye ½–¾ hour at 80°–90° C., 2.0–4.0 gms. dye.

By using 0.2–0.3 gm. $SnCl_2$ with the alum much brighter colors are obtained.

No. 3.
Mordant 1–1½ hours with 0.8 gm. $SnCl_2$ crystals and 0.8 gm. Tartar, wash, and dye in separate bath 30–40 minutes at 80°–100° C., 2.0–4.0 gms. Wood.

QUERCITRON.

Use Flavin; 1 *Fl.* = 16 *Quer.*
Canary-yellow.—No. 1 (10194, 10196).
Boil ½–¾ hour in solution of

$SnCl_2$	0.8 gm.
$H_2C_2O_4$	0.4 "

Take out wool and add 0.100 gm. Flavin mixed to a paste; boil 5–10 minutes, re-enter wool, and continue to boil ½–1 hour.

Oxalic acid may be replaced by Tartar or Tartaric Acid. More $SnCl_2$ yields brighter and redder shades.

Bright orange.—No. 2 (10195, 10197).
Same as above, using

Flavin	0.8 gm.

Quercitron Bark.
Olive-yellow.—No. 3 (10198, 10199).

K_2CrO_{27}	0.3 gm.

Mordant 1–1½ hours, wash, and dye in separate bath

Quercitron	4.0 gms.

No. 4. Same as above; use

Quercitron	8.0 gms.

Yellow.—No. 5 (10200) (single bath).

$Al_2(SO_4)_3$	0.4 gm.
$H_2C_2O_4$	0.2 "
Quercitron	2.0 gms.

Dye for 1–1½ hours at 80°–100° C.

No. 6 (10201).

Mordant 1–1½ hours with 0.8 gm. $Al_2(SO_4)_3$, wash, and dye in separate bath ½–¾ hour at 80°–90° C., 4.0 gms. Bark.

No. 7 (10202).

$CuSO_4$	0.6 gm.

Mordant, wash, and dye in separate bath of

Quercitron	4.0 gms.

for ½–¾ hour at 80°–90° C.

Quercitron Spirits.—No. 10203.

Quercitron Bark	1.00 gm.
Tartar	0.5 "
$SnCl_2$	0.15 "

(Same as Lac scarlet.)

Boil 20 minutes, cool down, enter wool, and boil 1 hour.

The bark was put in a bleeding bag and soaked over night.

SUMACH.

No. 1. *Reddish-brown.*—No. 10188.

$K_2Cr_2O_7$	0.3 gm.

Mordant 1–1½ hours, wash, and dye in separate bath.

Sumach	4.0 gms.

Avoid too high heat and add glue solution.

Yellow.—No. 2 (10189).

$SnCl_2$	0.8 gm.
$H_2C_2O_4$	0.4 "

Mordant ½–¾ hour and take out wool; add 4 gms. Sumach, boil 10 minutes, re-enter wool, and boil ½–1 hour.

No. 3 (10190).

$Al_2(SO_4)_3$	0.8 gm.

Mordant 1–1½ hours, wash, and dye in separate bath of

Sumach	4.0 gms.

½–¾ hour at 80°–90° C.

No. 4 (10191) (single bath).

$Al_2(SO_4)_3$	0.4 gm.
$H_2C_2O_4$	0.2 "
Sumach	4.0 gms.

Dye 1–1½ hours at 80°–90° C.

No. 5 (10193).

$FeSO_4$	0.8 gm.
Tartar	0.3 "

Mordant, wash, and dye in separate bath of

Sumach	4.0 gms.

for 1–1½ hours at 80°–90° C.

No. 6 (10192).

$CuSO_4$	0.6 gm.

Mordant, wash, and dye in separate bath of

Sumach	4.0 gms.

for 1–1½ hours at 80°–90° C.

PERSIAN BERRIES.

No. 1 (10214, 10215, 10216, 10217).

$SnCl_2$	0.4 gm.
Tartar	0.2 "
Persian Berries	1.0 "

Boil ½–¾ hour and remove wool; add berries, boil 10 minutes, and add equal bulk of cold water; remove to water-bath, enter wool, and treat 1 hour at 80°–90° C.

No. 2 (10218, 10219, 10220, 10221).
Same, using

Persian Berries	4.0 gms.
$SnCl_2$	0.8 gm.
Tartar	0.4 "

No. 3 (10222, 10223, 10224).
Same as No. 1; use 0.2 gm. $H_2C_2O_4$ instead of Tartar.

No. 4.
Same as No. 2; use $H_2C_2O_4$ instead of Tartar.

Yellow.—No. 5 (10212).

$Al_2(SO_4)_3$	0.8 gm.
Persian Berries	4.0 gms.

Treat as in No. 1.

No. 6 (10213).

$FeSO_4$	0.4 gm.
Tartar	0.3 "
Persian Berries	

Treat as in No. 1.

TURMERIC.

Yellow.—No. 1 (10084).

$Al_2(SO_4)_3$	0.8 gm.
Turmeric	4.0 gms.

Mordant and dye.

Olive.—No. 2 (10085).

$K_2Cr_2O_7$	0.3 gm.
Turmeric	4.0 gms.

Same as No. 1.

Brown.—No. 3 (10086).

$FeSO_4$	0.8 gm.
Turmeric	4.0 gms.

Same as No. 1.

Yellow.—No. 4 (10083).

Turmeric	4.0 gms.

Same as No. 1.

Yellow.—No. 5 (10087).

$SnCl_2$	0.4 gm.
Turmeric	4.0 gms.

Same as No. 1.

No. 6 (10088).

$CuSO_4$	0.6 gm.
Turmeric	4.0 gms.

Same as No. 1.

BARBERRY ROOT.

No. 1 (10089) (alkaline bath).

$K_2Cr_2O_7$	0.3 gm.
Mordant, wash, and dye in separate bath of Barberry Root	5.0 gms.

No. 2 (10090).

$Al_2(SO_4)_3$	0.8 gm.
Mordant, wash, and dye in separate bath of Barberry Root	5.0 gms.

No. 3 (10093).

$SnCl_2$	0.8 gm.
HCl	q. s.

Mordant, wash, and dye in separate bath of

Barberry Root	5.0 gms.

No. 4 (10091).

$CuSO_4$	0.6 gm.

Mordant, wash, and dye in separate bath of

Barberry Root	5.0 gms.

No. 5 (10092).

$FeSO_4$	0.4 gm.
Tartar	0.3 "

Mordant, wash, and dye in separate bath of

Barberry Root	5.0 gms.

CATECHU.

No. 1 (10205).

Catechu	2.00 gms.

Boil 1–1½ hours; sadden in separate bath of

$K_2Cr_2O_7$	0.4 gm.

for ½ hour at 80°–100° C.

No. 2 (10206).

Same as No. 1, but sadden in bath of

$CuSO_4$	0.6 gm.

No. 3 (10207).

Same as No. 1, but sadden in bath of

$FeSO_4$	0.4 gm.

No. 4 (10208).

Same as No. 1, but sadden in bath of

$Al_2(SO_4)_3$	1.00 gm.

No. 5 (10209).

Same as No. 1, but sadden in bath of

$SnCl_2$	0.4 gm.

LOGWOOD.

Gray.—No. 10094.

Logwood	0.5 gm.

Boil; then treat in separate bath of

$K_2Cr_2O_7$	0.1 gm.

Wash well.

Purple.—No. 10095, 10099.

Mordant the wool with

$SnCl_2$	0.600 gm.
Tartar	0.900 "
HCl	2 or 3 drops.

Boil for 1 hour, take out, and dye in a separate bath of

Logwood	1.5 gms.
Distilled water	q. s.

Blue.—No. 10096, 10097.

Mordant for 1–1½ hours at 100° C. in bath of

$Al_2(SO_4)_3$	0.4 gm.
Tartar	0.5 "

Wash well and dye in separate bath of

Chip Logwood	1.5–3.0 gms.
Chalk	0.2–0.3 gm.

for 1–1½ hours at 100° C.

Blue.—No. 10098 (using another mordant).

$K_2Cr_2O_7$	0.3 gm.
H_2SO_4 conc.	0.1 gm.

Same method. At the close of the operation add 0.5–1 per cent. $SnCl_2$.

Brighest blues are dyed at 90° C.

Black.—*Iron-black* No. 1.

Mordant for 1½–2 hours in bath of

$FeSO_4$	0.4 gm.
$CuSO_4$	0.2 "
Alum	0.2 "
Argol	1.2 gms.

Take out, wring, and let lie over night; dye 1½ hours at 100° C. in 4.0–5.0 gms. Logwood.

No. 2. Black.

Boil wool 1 hour with decoction of 4.0–5.0 gms. Logwood and 0.5–1.0 gm. Fustic, lift, and cool bath; add 0.4–0.6 gm. $FeSO_4$ and 0.2 gm. $CuSO_4$, re-enter wool, raise to 100° C. in ¾ of an hour, and boil ½ hour longer.

Black.—No. 10100.

Mordant 1–1½ hours at 100° C. in bath

	$K_2Cr_2O_7$	0.3 gm.
	H_2SO_4	0.1 "
Or,	$H_2C_2O_4$	0.4 "
Or,	$H_2C_4H_4O_6$	0.6 "

Wash, and dye in separate bath 1–1½ hours at 100° C. of 3.5–4.0 gms. Logwood and 0.5 gm. of old Fustic; finally pass through a warm bath of 0.5 per cent $K_2Cr_2O_7$, using Oxalic Acid. We can recommend this bath as giving fine results.

Black on Yarn.

Mordant in bath of

$K_2Cr_2O_7$	0.2 gm.

for 1½ hours at 100° C., drain, and dye in bath of

Logwood Extract, 51° Tw.	1.50 gms.

for 2½ hours at 100° C., bath should be acid with Acetic Acid; allow to cool over night in bath, wash, and dry. Results are very good.

The dyeing with indigo on a small scale not proving successful, is omitted; the best results, however, may be obtained with the sulphite vat.

The following recipes from a practical American wool-dyer are added to this article with the hope that they may prove of value to some of the readers:—

Recipes to Dye Wool Black.

(100 pounds clean Wool.)

No. 1.

Prepare with

Blue Vitriol ($CuSO_4$)	1½ pounds.
Copperas ($FeSO_4$)	3 pounds.

Boil wool 1½ hours, then take out of the tub and drain; throw away this liquor.

Color with

Chip Fustic	10 pounds.
Chip Logwood	15–35 pounds.

The quantity of Logwood depends upon how intense a color is wanted.

Boil chips in a bleeding bag 2 hours before putting in the wool; boil wool in this liquor 1½ hours, turn off steam, and let the wool remain in the liquor until it cools—2 hours or longer; then drain off the liquor.

No. 2.

Prepare with

Bichromâte of Potash ($K_2Cr_2O_7$)	2 pounds.

Boil wool 1½ hours, then take it out of the tub to drain, and throw away the liquor.

Color with

Chip Logwood	15–30 pounds.

The quantity depends upon how intense a shade is required.

Boil chips in bleeding bag 2 hours and treat wool as in recipe No. 1.

Where there is time, permit the wool to remain in the preparation (in either recipe) 2 hours after it is boiled, and let the liquor cool before draining it off; the wool is of softer feeling than if pushed through quickly.

Scarlet Lac Dye Spirits.

Nitric Acid	2 parts.
Muriatic Acid	1 part.
Water	2 parts.

Slowly add 2 ounces of feathered Tin to each pound of this liquid.

If the Tin be added in too great a quantity at once, it will fire the Spirits, precipitate Oxide of Tin, and render the spirits useless. It generally takes about 2 days to make good Lac Spirits.

For 100 pounds of wool (clean):—

15 pounds of Lac Dye, 5 pounds of White Tartar, and 5 quarts (imperial) of above Spirits.

Boil solution 20 minutes, cool off a little, enter wool, and boil 1 hour; shut off steam and let it soak at least 3 hours, then rinse (if yarn, rinse in cold water; if wool, rinse in water at 100° F.).

Use more or less Lac Dye, according to shade.

Cochineal Scarlet.

Same as Lac Dye, with the exception that the Spirits are entirely of Muriatic Acid, with 2 ounces of Tin to each pound of acid, and the Tin may be added all at once without danger.

Use one-third less Cochineal than Lac Dye.

Yellow (Quercitron).

Wool (clean)	100 pounds.
Quercitron Bark	10 pounds.
White Tartar	5 pounds.
Muriate of Tin	5 quarts.

Treat in same manner as Scarlet Lac Dye.

There is no yellow colored with Fustic nowadays, and Welds are only used on silk.

Indigo-blue.

There can be no recipe given for indigo-blue that would be of any service on a small scale. The following is used in a dye-house near New York.

Put into a vat 7 by 7 feet, heated by a coil to 160° F.

Woad	500 pounds.
Indigo	30 pounds.
Madder	10 pounds.
Wheat-bran	5 pounds.

After standing 12 hours it will require from 15 to 30 quarts of sifted Caustic Lime, added gradually (about 2 quarts at a time) in the course of from 48 to 72 hours.

It will be at once seen that the success of the process depends upon the skill of the operator.

The Wool is steeped in the bath, then removed and allowed to dry in the air, washed, and dipped again; repeat until the desired shade is obtained.

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H. T. VULTÉ,
Recording Secretary, Editor of the Transactions.

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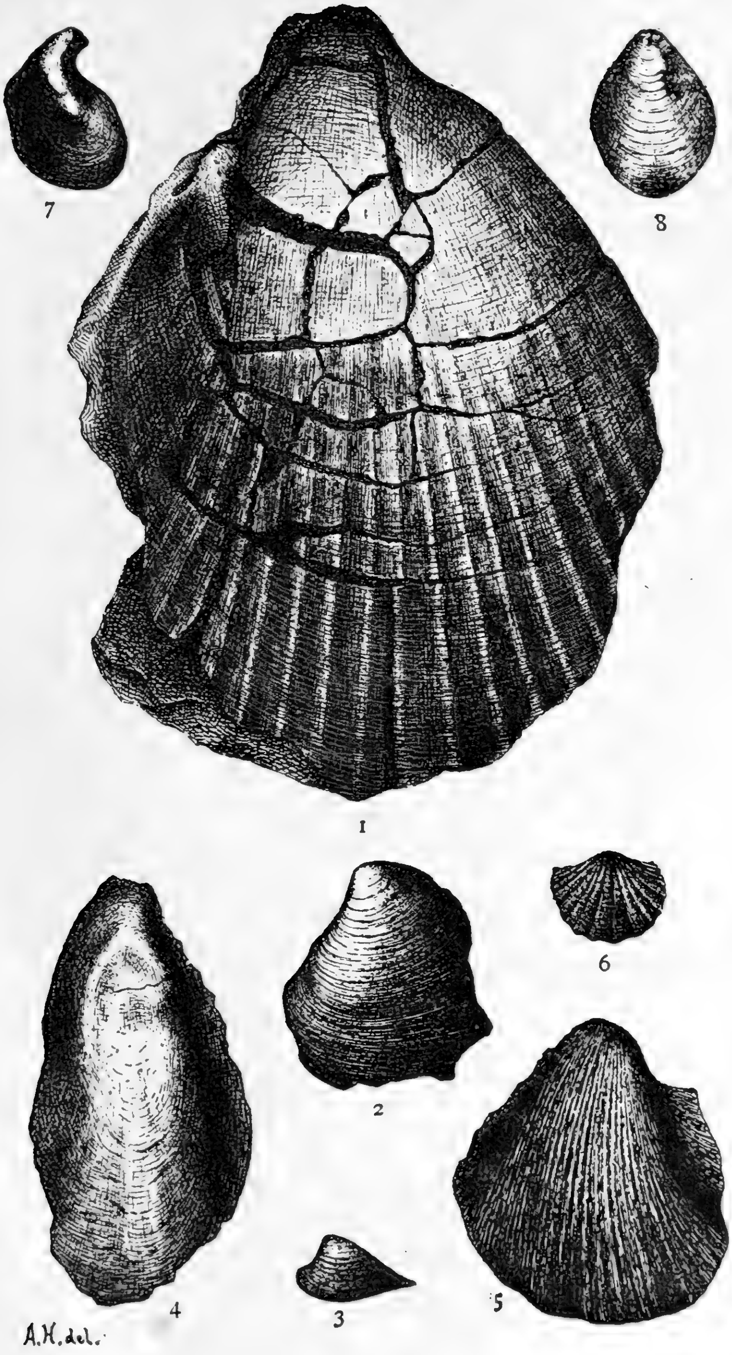

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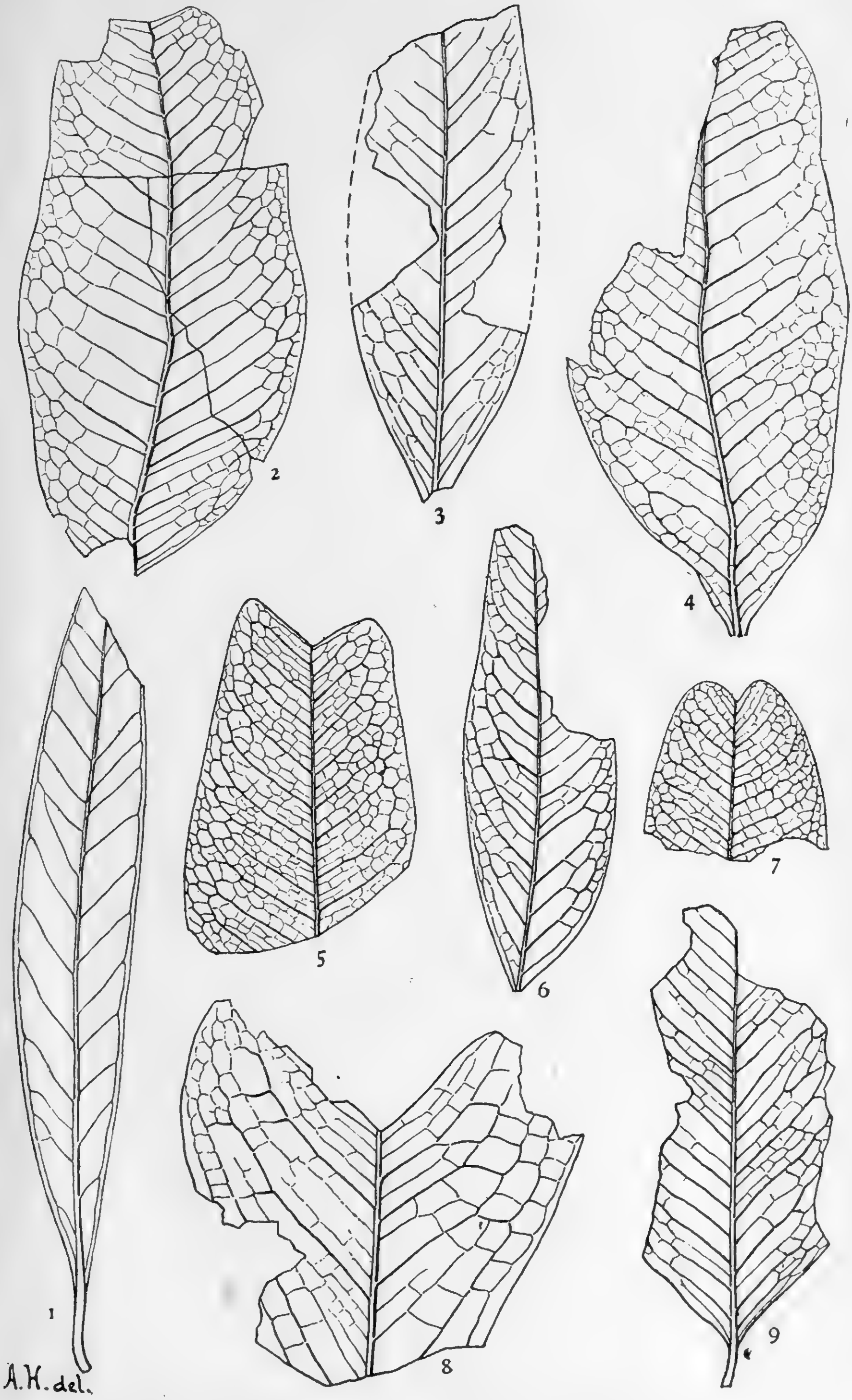

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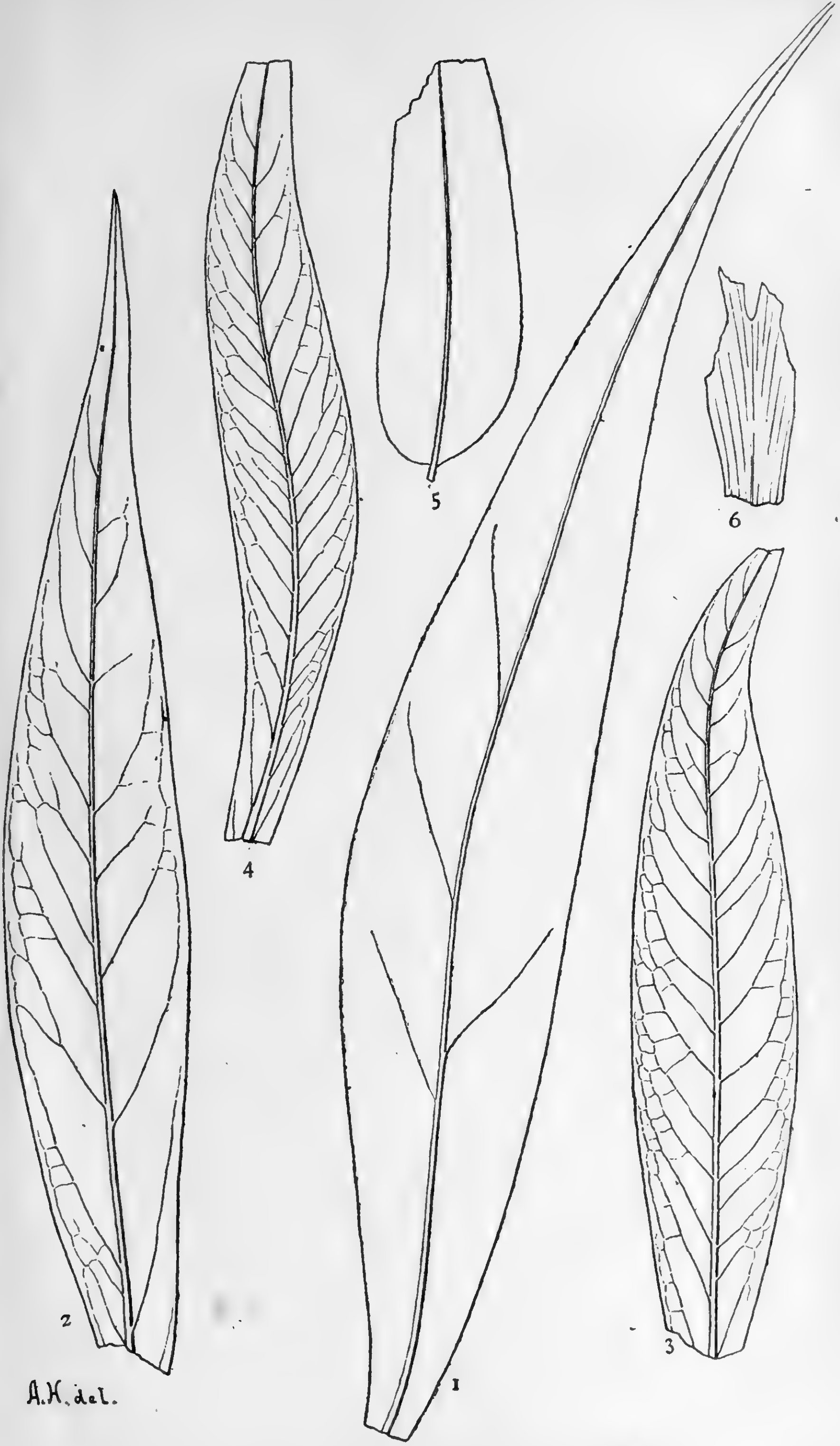

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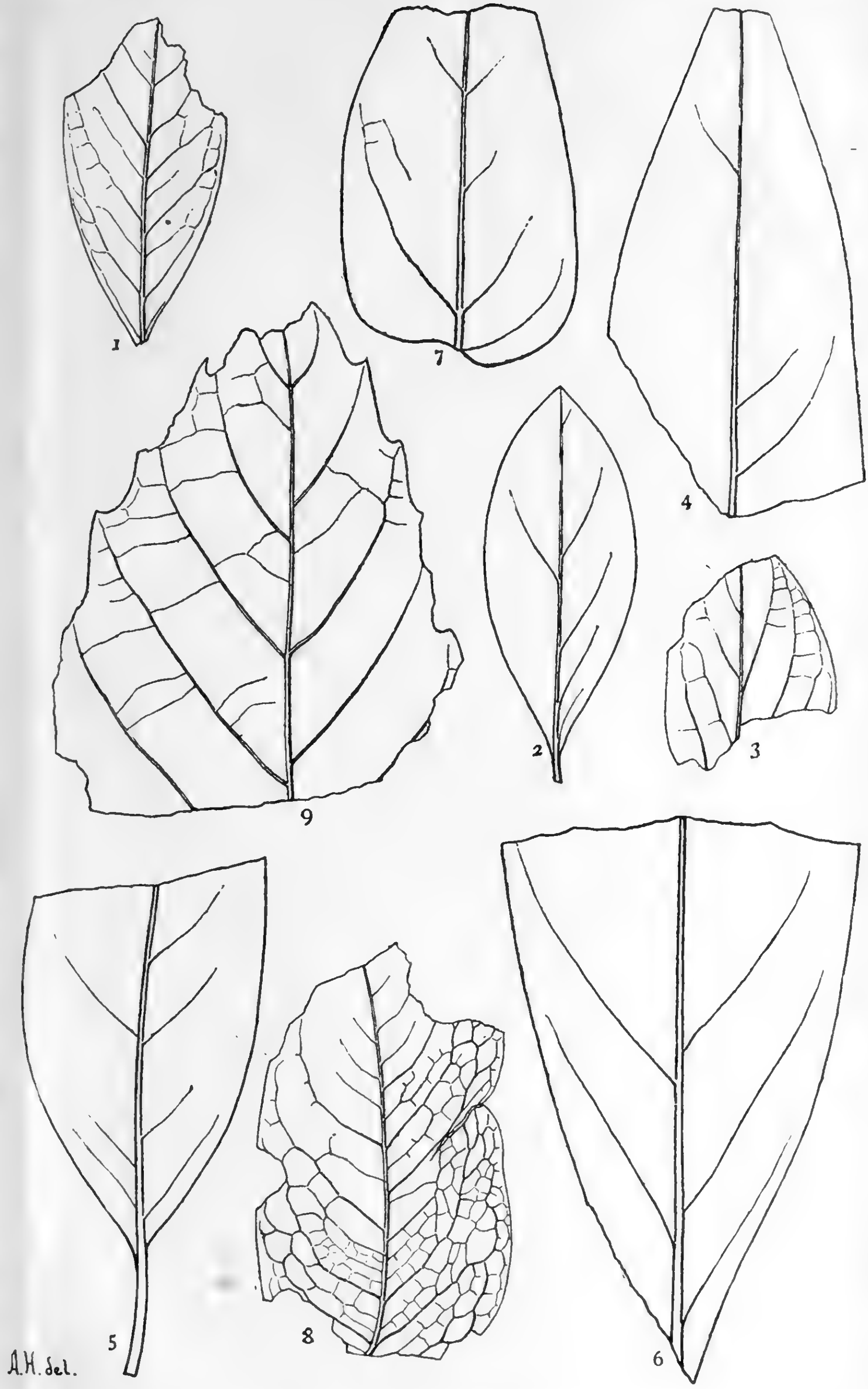

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