PROCEEDINGS

OF THE

AMERICAN ACADEMY

OF

ARTS AND SCIENCES.

VOL. IV.

FROM MAY, 1857, TO MAY, 1860.

SELECTED FROM THE RECORDS.

BOSTON AND CAMBRIDGE:
WELCH, BIGELOW, AND COMPANY.
1860.

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VOL. IV.

Four hundred and fortieth meeting.

May 26, 1857. — ANNUAL MEETING.

The PRESIDENT in the chair.

Dr. A. A. Gould, from the Committee on the Library, made the annual report upon the condition of the library.

Professor Lovering, in behalf of the Committee on Publications, made his annual report.

The Treasurer presented his annual report upon the finances of the Academy; which was ordered to be entered in full upon the record-book.

The President read a list of the Fellows, Associate Fellows, and Foreign Honorary Members chosen during the past year. Also a list of those deceased since the last annual meeting, as follows: —

Resident Fellows.

Hon. Samuel Hoar, of Concord.
Hon. Francis C. Gray, of Boston.
Rev. Dr. Ephraim Peabody, of Boston.

Associate Fellow.

Prof. Jacob Whitman Bailey, of West Point.

Foreign Honorary Member.

Dr. Buckland, the late Dean of Westminster.

The vacancies in the list of Foreign Honorary Members were filled by the election of

Professor Mitscherlich, of Berlin, in Class I. Section 3;

Professor Hugo von Mohl, of Tübingen, in Class II. Section 2;

Jacob Grimm, of Berlin, in Class III. Section 2.

The following gentlemen were elected Fellows of the Academy: —

John D. Runkle, of Cambridge, in Class I. Section 1.

Dr. David Weinland, of Cambridge, in Class II. Section 3.

Moses G. Farmer, of Boston, in Class I. Section 3.

Dr. Charles G. Putnam, in Class II. Section 4.

Professor Gray read the following note in reference to the life and services of the late Professor Bailey: —

"Jacob Whitman Bailey, late Professor of Chemistry, Mineralogy, and Geology in the U. S. Military Academy, West Point, — the only Associate Fellow lost to the Academy by death during the past year, — died on the 27th of February last, at a comparatively early age. He was born on the 29th of April, A. D. 1811, in the township of *Ward*, now Auburn, in this Commonwealth. He was graduated at West Point, in July, 1832, when he received his commission of Second Lieutenant of Artillery. He was promoted to be First Lieutenant in August, 1836, and had charge of an arsenal in Virginia at the time of his appointment, in 1838, to the chair he so long and so worthily filled at West Point, at first as Assistant, and afterwards as principal Professor.

"His public scientific career began in the year 1837, with a communication printed in the American Journal of Science, On the Use of Grasshoppers' Legs as a Substitute for Frogs in Galvanic Experiments. Shortly after his removal to West Point, viz. in 1838, he commenced the publication, in the same Journal, of his important series of papers on the *Infusoria*, especially the *Diatomaceæ*, both recent and fossil, being the results of assiduous and long-continued observations on these minute organisms, which ended only with his life, — his latest paper, reporting the results of microscopic examination of the soundings across the Atlantic made in the voyages of the Arctic between the coast of Ireland and this country, having been published a few days after his lamented death.

"Other important papers on the same class of subjects have appeared in the Smithsonian Contributions to Knowledge. One of his most recent publications was a short paper, showing — contrary to Sir David Brewster's till then unquestioned statement — that silex in vegetables, as in the rind of the stem of Grasses and Equisetum, does not polarize light, and is not crystalline in structure. The apparent polarization he showed to be due to organic membrane, which had not been entirely removed. It must not be forgotten, moreover, that he was the first to *prove* the vegetable structure of coal (at least of anthracite), which he did in a characteristic way, at once simple and decisive, as may be seen by his paper on the subject in the American Journal of Science.

"Professor Bailey commenced his microscopical observations with simple lenses made by himself of fused globules of glass, using these, as well as better instruments, with extraordinary skill and success. He may justly be regarded as the founder of microscopical research in America, and himself as a model investigator. His published papers are all short, clear, explicit, and unpretending as they are thorough; and every one of them embodies some direct and positive contribution to science."

The officers of the Academy were elected for the ensuing year as follows: —

Jacob Bigelow, ...	*President.*
Daniel Treadwell, . .	*Vice-President.*
Asa Gray, ...	*Corresponding Secretary.*
Samuel L. Abbot, . . .	*Recording Secretary.*
Nathaniel B. Shurtleff,	*Librarian.*
Edward Wigglesworth,	*Treasurer.*

Council.

Joseph Lovering, E. N. Horsford, Benjamin A. Gould, Jr.	of Class I.
Louis Agassiz, Jeffries Wyman, John B. S. Jackson,	of Class II.

James Walker,
Francis Bowen, } of Class III.
Nathan Appleton,

The President announced the following Standing Committees: —

Rumford Committee.

Eben N. Horsford, Joseph Lovering,
Daniel Treadwell, Henry L. Eustis,
Morrill Wyman.

Committee of Publication.

Joseph Lovering, Louis Agassiz,
Cornelius C. Felton.

Committee on the Library.

Augustus A. Gould, Benjamin A. Gould, Jr.
Josiah P. Cooke, Jr.

To Audit the Treasurer's Accounts.

Thomas T. Bouvé, Dr. C. E. Ware.

Four hundred and forty-first meeting.

August 12, 1857. — Stated Meeting.

The President in the chair.

The Corresponding Secretary read the following letters, viz.: — From Jacob Grimm, Berlin, July 2, accepting his appointment as Foreign Honorary Member; from Dr. Charles G. Putnam and J. D. Runkle, accepting Fellowship; from the Linnæan Society, London, November 25, 1856, Royal Geographical Society, London, November 29, 1856, Académie Royale des Sciences à Amsterdam, January 5, 1857, Die Königl. Sächsische Bergakademie, Freiberg, January 19, 1857, Kaiserlich-Königliche Geologische Reichsanstalt, Wien, January 21, 1857, Corporation of Harvard College, March 10, 1857, Royal Society of Sciences, Göttingen, April 18, 1857, K. L. C. Akademie der Naturforscher, Breslau, May 4, 1857, Société Imperiale des Naturalistes de Moscou, Moscow, March 22, 1857, and the Academy of Natural Sciences of Philadelphia, June 19, 1857, acknowledging the receipt of the Academy's publications; from the Société de Geographie à Paris, February 7, 1857, and the Academy of Natural Sciences, Philadelphia, June 19, 1857, acknowledging the same, and requesting that missing parts may be supplied; from the Kaiserlich-Königliche Geologische Reichsanstalt, Wien, January 1, 1857, and the Société Royale des Sciences à Upsal, presenting their publications; from the Superintendent of the Geological Survey of India, &c., January, 1857, presenting the Memoirs of the Survey, and requesting an exchange; from the Verein für Naturkunde im Herzogthum, Nassau, May 1, 1857, presenting its transactions, and asking an exchange; and the Comet Circular of July 28, 1857, from Dr. C. H. F. Peters, at Albany, N. Y.

Dr. Charles T. Jackson made some statements concerning the various kinds of marble now being used in the government buildings at Washington, and incidentally spoke of the chemical action in different kinds of lime and cement.

Dr. Weinland spoke of the lime in use in Hayti, as entirely made from the shells of *Strombus gigas*.

Professor Felton announced to the Academy the organization of an Academy of Arts and Sciences at Athens.

The requisite quorum for the transaction of the proper business of a stated meeting not being present, on motion of Professor Treadwell, it was voted that the next regular meeting be an adjournment of the present one.

Four hundred and forty-second meeting.

September 8, 1857. — Adjourned Stated Meeting.

Professor Treadwell, Vice-President, in the chair.

Professor Guyot addressed the Academy at considerable length upon the general geographical features of New England, showing the influence they had exerted in fixing the successive settlements of this part of the country. He proposed to treat the subject more fully in a Memoir to be laid before the Academy.

Four hundred and forty-third meeting.

October 13, 1857. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read the following letters, viz.: — From the Académie Royale des Sciences, &c. de Belgique, January 15, 1856, and February 7, 1857, the Academy of Science of St. Louis, August 24, 1857, and the American Philosophical Society, September 10, 1857, acknowledging the receipt of the Academy's publications; from the Academy of Natural Sciences, July 7, 1857, acknowledging the same, and asking that missing numbers may be supplied; and from the Académie Royale des Sciences, Turin, May 15, 1857, acknowledging the same, and presenting its own publications.

Professor Lovering said, that, at a former meeting, — in making some remarks on the question, whether the Mississippi River flows up hill, — he alluded to a criticism of President Horace Mann (published in the Common School Journal) upon those who attributed the direction of the flow of this river to centrifugal force. Mr. Lovering had since learned from Mr. Mann that he recalled his opinion in the same Journal two years afterward. If Mr. Lovering had known this fact at the time he should not have alluded to the unsound criticism; and he wished now to give Mr. Mann the benefit of having recanted most fully his former error, before he himself took notice of the subject.

Dr. Weinland gave an account of a recent visit to the island of Hayti. He mentioned many interesting facts concerning the influence of the prevailing winds upon the surrounding sea, and its incidental effect upon the marine Fauna of that region, and the formation of a solid rock from the *débris* of shells and corals. Dr. Weinland also spoke of the vegetation of the island, and of the manners and customs of the inhabitants.

Four hundred and forty-fourth meeting.

November 11, 1857. — STATED MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from the Société des Sciences des Indes Neerlandaises, dated Batavia, April 18, 1857, desiring to know whether all of its publications which had been transmitted to the Academy had been received.

The following gentlemen were elected Fellows, viz.: —

Ezekiel Brown Elliott, in Class I. Section 1.

Frank H. Storer, in Class I. Section 3.

William T. Andrews, in Class III. Section 4.

Charles W. Eliot, in Class I. Section 3.

St. Julien Ravenel, M. D., of Charleston, South Carolina, and Professor Edward Robinson, LL. D., of New York, nominated by the Council, were elected Associate Fellows, the former in Class II. Section 3, the latter in Class III. Section 2.

Professor Horsford exhibited specimens of parchment paper, prepared from paper of a very loose texture, by dipping it into a mixture of two parts of sulphuric acid and one of water, and then rapidly washing it in cold water. The action of the acid probably converts the surface of the fibres into a gum, which, on hardening, cements the whole, and gives great strength to the paper.

Professor Horsford also exhibited specimens of Silicium; also of copper obtained from a deposit of Tripoli, about forty miles from Bangor, Maine.

Dr. S. S. Kneeland exhibited two specimens of Menobranchus from Portage Lake, near Lake Superior. He had had them in his possession since December, 1856, and from that time until the succeeding June they took no food. At the present time they devour earth-worms greedily. During the past winter, the water in which they were kept had repeatedly been frozen solid. They were pumped up from the lake, and it is only during the winter season that specimens are obtained.

Professor Horsford gave the results of several experiments by his pupils to determine the commercial value of saltpetre by a new method proposed by himself some time since, and then announced to the Academy. The results corresponded very accurately with each other, and with those obtained by more elaborate chemical processes.

Four hundred and forty-fifth meeting.

December 8, 1857. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from Professor Edward Robinson, accepting the Fellowship of the Academy.

Professor Agassiz spoke of the various existing systems of Classification of Fishes, characterizing them all as incomplete and artificial. He analyzed those of anatomists and zoölogists, showing how each failed to conform to the natural system. He referred to his own proposed classification, based on the characters of the scales, and said that he had given that up also as too artificial. The true indications, he thought, were to be found in the embryonic development of this class of animals. Development without an amnios or allantois is common, he said, to naked reptiles and fishes. The scaly reptiles, birds, and mammals are associated by their circulation as a natural group. Among fishes he recognized four groups on a par with the natural divisions of amphibians. He proposed the name of Salachians, to include the sharks and skates, which differ in the structure of their skeletons, brains, and in other particulars, from fishes proper. Next come the genuine Ganoids, with their reptilian affinities. The lamprey-eel is the only type which undergoes a metamorphosis in passing from the young to the adult condition. The four classes, then, among fishes are the Selachians, the Ganoids, Fishes proper, and Myzonts. Professor Agassiz explained how the position of the fins cannot be relied on as a character for the formation of natural groups. The sturgeons, loricarians, and cat-fish, he said, form a natural group, based on similarity of structure of the operculum and upper jaw, characters which he considered of more importance than the muscular bulbus of the aorta. These families are linked together also by the peculiar arrangement of the lateral line and the dorsal and abdominal shields.

Professor C. C. Felton announced the decease of a distinguished Associate Fellow of the Academy, Thomas Crawford, as follows: —

"I rise to announce the death of a Fellow of this Society, Thomas Crawford, the American sculptor.

"It is but a year since Mr. Crawford returned to Rome from a visit to the United States, leaving his family with their relatives. He was then apparently in full health, in the highest spirits, looking forward to future achievements; — already possessed of fame and fortune, domestic happiness, the love and admiration of friends, and of all else that makes the present delightful, and the prospect of the future brilliant and enchanting to a noble spirit. It is but a few days since his colossal bronze statue of Washington was landed at Richmond, and drawn by shouting and enthusiastic multitudes to the place of its destination, up the Capitol Hill of that beautiful city. Last Saturday the lifeless body of the great artist was borne by the pious hands of silent and sorrowing friends, to its final resting-place in Greenwood Cemetery.

"Thomas Crawford was born in New York, on the 22d of March, 1813. Early in life he showed, amidst the hardships of poverty, the irresistible promptings of a natural genius for sculpture, in which he was destined to gain a world-wide renown. In 1835 he was enabled to go to Rome, the true school for the sculptor, and there, with hopeful courage and manly heart, he dedicated his studious nights and laborious days, under the wise counsel and friendly aid of the great Thorwaldsen, to the simplest but sublimest of the arts. His earliest productions gave ample promise of future distinction. In 1839 Mr. Charles Sumner, then visiting Rome, saw the model of the Orpheus, and, admiring its chaste and classic beauty, undertook, with friendly zeal, to raise a subscription in Boston, that the work might be executed in marble. He was successful, and the Orpheus of Crawford is now one of the conspicuous ornaments of the gallery of the Boston Athenæum, and its rare merit established the fame of the young sculptor. In 1844 he returned to the United States, and was married to Miss Louisa Ward of New York. I need not dwell on the happiness which this marriage secured to him.

"The reputation of the artist increased, with the rapidly increasing number of his works. This is not the occasion to enumerate them, or to enter upon an elaborate criticism of their various and extraordinary merits. I have spoken of the first, and I have alluded to the last, the colossal monument of Washington, ordered by the patriotic State of Virginia, which remained, in some of its details, uncompleted at the time of his death. That monument will make the Capitol of Richmond a shrine to which the lovers of art will for ever make their pilgrimages, to gaze upon the sculptured form of the greatest of men, embodied by the genius of one of the greatest of modern sculptors.

"Mr. Crawford was a person of generous and manly character. He was bold without rudeness, frank and independent without forgetting the rights of others. In conversation he was animated, intelligent, and instructive. In manners he was unaffected, simple, and hearty. His genius was not only vigorous, but varied and affluent. His imagination was brilliant and fiery, but chaste and disciplined; and his hand was untiring in executing what his mind conceived. He loved to enthusiasm the beauty of Hellenic art, and was an unerring but kindly critic of the productions of the moderns, and of his living contemporaries. He was alike familiar with the boundless treasures of the Vatican and of the Capitol, and with the vast variety of works in the studios of the artists of all nations at Rome. From what I saw and heard of him there, I am sure it will be the verdict of his brethren, that he has hardly left his peer in the Eternal City.

"In 1856 Mr. Crawford came on a visit to the United States; and his friends were struck by the unbroken vigor of his health, and the animation and joy of his discourse. But even then the disease — a cancer on the brain — which closed his life had made some progress unknown to himself. On his return in the autumn to Rome, it soon demanded attention. An examination was made, and an operation was performed by a skilful surgeon, to ascertain precisely the nature of the disease. It was found to be malignant, and probably incurable. He went to Paris, under advice, and the ablest surgeons of that city pronounced the case a hopeless one. But that nothing should remain untried that might hold out the slightest possibility of benefit, he was removed from Paris to London, and placed under the care of a professional man who had made a special study of this class of diseases. It was all in vain. Crawford died on the 10th of October, having borne the protracted agonies of his long illness with the fortitude of a hero and the resignation of a Christian. The consolations of friendship, of domestic love, and of religious faith, surrounded his dying-bed. He calmly arranged all his earthly affairs, and prepared his soul for the last scene; and he departed with the serenity of one who was conscious of a life consecrated to noble pursuits and generous affections, and who felt an unwavering faith and entire submission to the will of God. He has left to his successors an illustrious example; he has bequeathed to his country a renown that ranks him with the great sculptors of ancient Athens and modern Rome; he has left a name which the most distant ages will not let die.

"I move the following resolutions: —

"*Resolved*, That the members of the American Academy of Arts and Sciences have heard with deep regret of the death of their late associate, Thomas Crawford, the distinguished sculptor. In his character they recognize the noblest virtues, and in his works a large contribution to the glory of the American name in one of the highest walks of art. In his death, the country and the world have lost one of the most brilliant men who have done honor to the present age.

"*Resolved*, That the members of this Association sincerely sympathize with the family and friends of the deceased in this their great bereavement; and that a copy of these resolutions be communicated to Mrs. Crawford by the Corresponding Secretary."

The resolutions were unanimously adopted.

Dr. W. F. Channing exhibited photographs, of various sizes, of the late Rev. W. E. Channing, D. D., taken by Whipple from Gambardella's portrait. He also exhibited specimens of Breckenridge bituminous coal from Kentucky, from which paraffine is now manufactured, specimens of which were shown, together with candles made from this substance.

Professor Horsford spoke of certain curious knolls which are found in Western New York after the forests are cut down, and are always indicative of the presence of gypsum. The heat of the sun acting on the soil after the removal of the forests, the gypsum in solution rises by capillary action to sustain the evaporation, and takes on crystalline form as soon as it reaches a point where the water, reduced by evaporation, becomes insufficient to hold it in solution. These crystals, pushing up from below, raise the ground into the form of a knoll, sometimes six or eight feet in diameter, and from one to two feet high. The bed of gypsum is usually found within a few feet of the surface of the ground.

Four hundred and forty-sixth meeting.

January 12, 1858. — Monthly Meeting.

The Academy met at the house of the Hon. Thomas G. Cary.

The President in the chair.

Professor Lovering made a communication in regard to the Australian instrument, called the *boomerang*, under the following heads : — 1. Its History and Antiquity. 2. Its Shape. 3. Its Use. 4. Its Mechanical Theory. 5. Its Experimental Illustration. He gave upon the blackboard a simple mathematical analysis, to show why it deviated from the vertical plane, why it retrograded, and at what angle of elevation these effects were at a maximum.

Professor W. B. Rogers made some remarks upon the variations of its movements, in actual practice, from the results of abstract calculation, and the cause of these variations.

Mr. Cary exhibited to the Academy a large photograph which he had lately brought from Milan, taken recently from the celebrated painting of the Last Supper, by Leonardo da Vinci, in the Refectory of the Dominican Convent in that city. He exhibited at the same time the well-known engraving of the same picture by Raphael Morghen, to show, by comparison of the two, that the engraving is not a close copy of the original, there being marked differences in the features of several of the figures; and, while the attitudes are similar, the expression in several of them, particularly in the principal figure, is so unlike, as to account for the impression generally received, by those who see the original, of its great superiority to the engraving in dignity and power. It has been said that the drawing was not good from which the engraving was made, and that, in some instances, heads copied from detached sketches left by Leonardo da Vinci were substituted in it for those which he finally adopted as best suited to express his own conception. It is to be remembered, however, that the engraving of Morghen has roused a general interest in the subject, that tends strongly to preserve what remains of this extraordinary picture, after its injuries by flood and war, as well as by decay from the lapse of time.

He likewise exhibited to the Academy a picture of great age and beauty, now in his possession, which has been supposed to be by Leonardo da Vinci, and gave an account of some peculiar circumstances under which it was brought to the United States. Early in this century, when the armies of Napoleon were in Spain, on the approach of a large body of troops, some pictures were hastily removed from a church for safety; and it was afterwards found that, in the confusion, one of them, a painting of great value, had been carried to the coast. A courier was despatched with authority to recover it, but found, on his arrival at the seaport, that it had been offered there for sale, and purchased by an American captain, who had sailed for the United States. A letter was then addressed by a commercial house to Mr. Nelson, a prominent merchant at that time in New York, stating these facts, with the name of the ship and captain, and desiring him to repurchase the picture and send it back to Spain, whatever might be the cost. On inquiry, he found that the captain had arrived and sailed again on a long voyage. Mr. Nelson waited his return, and having ascertained that he had the picture, before attempting any negotiation for it wrote back to Spain to inquire whether he still had unlimited authority to purchase it. Receiving no answer, he supposed that the parties interested in the subject were dead or driven away, as everything was then in confusion.

Many years afterward he mentioned this picture, as one that was likely to be of great value, to a gentleman in New York, who had a great love for paintings. Mr. Cary, then residing in New York, was applied to for information of the captain, who belonged to Boston, and who said, when asked, that he still had the picture, that it had been a great favorite with his wife, and that during her life he never would have parted with it; but that since her decease he was without a home, and had no objection that the picture should go where it would be more seen and admired. It was accordingly purchased.

It was found to be on a thick panel of hard and very old wood. The subject was the Madonna and Child, but the figure of the latter, with little of the sacred gravity that is given in the Madonna della Seggiola of Raphael, and by other masters, was rather that of a playful, curly-headed boy, which at first caused some persons to suppose that it might be intended for Hagar and Ishmael. It presented in another respect a peculiar appearance. One part of the painting seemed to be the work of a great master, while another part was of a very inferior order. A German artist, then living in New York, who had extensive knowledge of pictures and considerable skill in repairing them, was called to examine it. After close attention, he asked for a needle, and showed that the part which was admired was impenetrably hard, and obviously the original work of the artist, while the paint on the other part was soft, and no doubt had been put on by some one who had undertaken to make repairs. The artist said that all this, with a thick coat of varnish, should be removed, and that it could only be done safely by rubbing it with his own hand. When this was done, the picture had a mottled appearance, as if worms had attacked the wood and penetrated through the paint in spots. The painting was afterwards sent to London, and completely restored by a person of great skill, who was at that time intrusted with the most valuable pictures that needed such repairs in England. When he had received and examined it, he inquired by whom it was supposed in America to have been painted; and was told that it was thought to be by Leonardo da Vinci; to which he replied, "That may very well be."

Mr. Cary remarked further, that when in Europe recently, retaining a vivid recollection of this picture, although he had not seen it for some years, (having only received it here within a few days as the bequest of a near relative, who had purchased it from the captain,) he had sought an opportunity to see, if possible, among the few undoubted paintings of this great master that remain, some one of the same subject, and found such a one in the Brera at Milan. It is unfinished, but the attention of visitors is directed to it in the catalogue, as among the most valuable to be seen there. As Leonardo was a man of varied powers, exercising them all, and had even, while at Milan, planned and superintended the work on a canal for the Duke, it is not surprising that he should have left a picture there unfinished. The Madonna in that is different, but the child is very similar.

Mr. Cary also drew the attention of the Academy to several other pictures, chiefly bequests from the same collection.

One of them is a good specimen of the Pre-Raphaelite manner, with its hard outline, by Francesco Francia, who is said to have been an instructor of Raphael; and although that fact is not well established, the report, if such evidence were necessary, would mark him as one of the masters of his time. Mr. Cary was told recently in Rome, where this picture was obtained, that it is well remembered there as "The Eternity"; a female figure on a mound, holding a circle in one hand, and pointing upward with the other.

Another painting exhibited by Mr. Cary is supposed to be a portrait of Titian, painted by himself in extreme old age. It was taken by a corsair in the Mediterranean from a Spanish vessel, and carried into Tunis, when the American consul there was the late M. M. Noah, who became possessed of it, and brought it to New York about forty years ago. It is said that Titian was in Spain late in life, and that he painted to the last.

A third is a large picture of Dogs watching Game, supposed to be by Sneyders and Rubens. It is well known that they frequently united their powers, the latter painting the landscapes. Mr. Cary remarked, that a few months since, in the great exhibition at Manchester, containing many of the choice pictures of England, he had seen one, unquestionably by Sneyders and Rubens, which confirmed the belief that the landscape in this is by Rubens. Although Sneyders usually preferred the violent action of a hunt, he sometimes painted quiet scenes like this. The picture once belonged to an old family in one of our Southern States, and was probably brought to this country far back in the last century.

Another is an old and interesting picture, bearing some resemblance to the manner of Murillo, brought a long time ago from Smyrna, where it was left with some others by a Spanish artist, who died there. The subject is "The Education of the Virgin Mary," from the traditions of the Romish Church.

There were also a Magdalen by Guido, with strong marks of his style; and a Watteau, "The Country Party," obtained in Paris from the collection of the Duc de Choiseul, after the French Revolution.

Professor J. Wyman said that he had recently had an opportunity of examining a human fœtus of the very early period of from the twentieth to the twenty-fifth day from conception. There were many points in its structure at that time which corresponded to the permanent condition in some of the lower animals. Some of these he proceeded to point out, illustrating his remarks on the blackboard. The eyes were found at this stage of development very far apart, in a position on each side of the head, similar to that which is permanent in fishes and some of the lower mammals, and very small. The mouth and nostrils formed but one cavity, which would be divided off subsequently by the growth from above and on the sides. It was evident that the deformity known as "hare-lip" is only an arrest of development at this stage. The lateral position of the nostrils is like that which is seen in some of the adult monkeys of the New World. The branchial fissures, resembling the gill-openings in fishes, are also visible at this early period, and one of them is known occasionally to remain at maturity. The extremities were merely in a rudimentary state, corresponding to what is sometimes seen in a certain class of monstrosities after birth. A rudimentary tail also existed, turning upwards towards the abdomen, and extending considerably beyond the rudimentary legs, subsequently to be surrounded and concealed by the downward growth of these extremities and the pelvis. Professor Wyman also stated a fact, which he thought had not been heretofore noticed, that the yolk-sac grows and forms new granules some time after the development of the fœtus has commenced.

Professor Agassiz referred to a subject which had puzzled both botanists and zoölogists,—the question of individuality. What constitutes an individual? He spoke of the various opinions of botanists on the subject, showing how difficult it had been to distinguish between individuals and organs. Professor Braun considers independent axes in plants as constituting independent individuals. The same question has divided zoölogists. Corals have by some been regarded as communities. Jelly-fishes have also been considered as compound beings. The question could only be determined, he thought, from a morphological point of view. A gamopetalous flower, in which all the petals are united, if we consider it with reference to this fact, has a striking resemblance to the medusa bell, the pistil in the flower being represented by the proboscis in the medusa. Professor Agassiz gave an account of the origin of Eudoxia and Aglaisma from the Diphyes, and pointed out the resemblance of the phenomena to those occurring in the vegetable world. There are thus, he said, diœcious communities, and there are also monœcious communities, among animals, as well as plants ; and he gave instances in illustration. The combinations of the sexes in their arrangement and order of succession along the parent stem were seen to resemble exactly those occurring among plants, while in some instances the order was the reverse of that in the vegetable world, seeming to complete the series, as it were. The conclusion, therefore, to which Professor Agassiz had been led, by these curious zoöphyte forms of animal life, was, that, as the animal buds are certainly individual existences, their representatives in the vegetable world, viz. the analogous buds or axes, should likewise be regarded as individuals.

Dr. T. M. Brewer exhibited some plates of birds' eggs, remarkable for their perfect representation of the originals, which had been obtained by an application of the photographic process. The eggs were first photographed on a very small scale, to do away as much as possible with the aberration of sphericity, and from these photographs a second set was obtained, of the full size of the egg, which were transferred to stone and printed in colors. The result was a most perfect exhibition of the spots and markings of these objects, hitherto so difficult to delineate.

Four hundred and forty-seventh meeting.

January 27, 1858. — Stated Meeting.

The President in the chair.

The Corresponding Secretary read the following letters, viz.: — From the Director of the Observatory of Breslau, March 2, 1857; Naturhistorischer Verein, Bonn, April 20, 1857; Royal Society of Sciences at Upsal, May 18, 1857; Zoölogisch-Botanischer Verein, Vienna, June 23, 1857; Académie Royale des Sciences de Stockholm, July 10, 1857; Royal Society of London, August 6, 1857; Royal Observatory, Greenwich, August 8, 1857; Société des Arts et des Sciences de Batavia, October 20, 1857; and the Society of Arts, Manufactures, and Commerce, London, November 19, 1857, acknowledging the receipt of the publications of the Academy; — from the Naturhistorischer Verein, Bonn, April 20, 1857; Académie Royale des Sciences de Stockholm, July 10, 1857; and the Royal Observatory, Greenwich, December 3, 1857, presenting their various publications; — also from the Zoölogisch-Botanischer Verein, Vienna, June 10, 1857, presenting its Transactions, and acknowledging the receipt of the Academy's publications.

Professor Agassiz presented a paper by Professor J. D. Dana, entitled, "On a Medusa of the Family related to Stephanomia," accompanying it with some observations of his own.

Mr. Sherwin exhibited a Leyden jar, showing curious figures on its upper surface, caused by the explosion of gunpowder upon it by electricity.

Dr. A. A. Hayes gave an account of the probable cause of the recent death from the combustion of gas in Davis's gas-stove. His remarks were followed by a conversation on the general subject of noxious gases, as exhaled from the ground, or otherwise generated, in which the President, Professor Rogers, Dr. Weinland, and Mr. F. H. Storer took part.

Four hundred and forty-eighth meeting.

February 9, 1858. — MONTHLY MEETING.

The Academy met at the house of the Rev. Dr. Frothingham.

The PRESIDENT in the chair.

The Corresponding Secretary read letters, from E. B. Elliott, accepting Fellowship; from the Royal Institution of Great Britain, November 18, 1857, and the Geological Society of London, December 3, 1857, acknowledging the receipt of the Academy's publications.

Mr. Folsom exhibited to the Academy a copy of an ancient inscription obtained by him at Susa, on the north coast of Africa, some years since. The block bearing the inscription was placed in the corner of a shed-like building, and was probably the pedestal of a statue. The inscription is as follows: —

L·TERENTIOAQVI	L. Terentio Aqui-
LAEGRATTIANO	læ Grattiano
QVAESTORIPRO	Quæstori Pro-
VINCIAEAFRICAE	vinciæ Africæ
AMICIOBPAREM	Amici ob parem
INVNIVERSOSATQVE	in universos atque
TALEMETPROPRI	talem et propri-
VMINSINGVLOS	um in singulos
HONOREM	honorem.

The exact signification of this inscription was commented on by several gentlemen, and its obscurity noticed. Professor Torrey suggested the word AEQVITATEM for the words ATQVE TALEM, as a reading which clears up the sense; Mr. Folsom having spoken of the inscription as being made out with difficulty, thus leaving room for the possibility of an error in copying.

Dr. W. F. Channing exhibited specimens of lithographs made by means of a new application of photography. The process is known as Photo-lithography, and consists in receiving upon a prepared lithographic stone the image of the object. After many experiments, Messrs. J. H. Cutting, Photographer, and L. H. Bradford, Lithographer, have succeeded in so preparing the stone that the figure thrown upon it from the camera is fixed permanently there, and can be printed from as an ordinary drawing. The discovery promises to be of very great value in the arts.

Professor A. Gray, referring to the popular opinion that squashes are spoiled by pumpkins, and melons by cucumbers or squashes, &c., when grown near each other, in consequence, as was thought, of cross-fertilization, remarked that it was a question whether the deterioration or alteration showed itself in the fruit of the season, that is, in the altered character of the ovary which had been acted upon by alien pollen, or only in the next generation, i. e. in the cross-bred fruit. The former was the popular idea, or at least the more common one; but if it was a case of cross-breeding, the alteration would naturally be looked for only in the progeny. As throwing some light upon this question, he gave an account of Naudin's recent investigations upon the cultivated *Cucurbitaceæ*, showing that the *species* of *Cucurbita* (which, as to those in ordinary cultivation, Naudin had reduced to three or four) refuse to hybridize; but that the application of the pollen of one species to the stigma of another, from which its own pollen is excluded, often causes the fruit to set and grow to its full size, although no embryos are formed in the seeds. Thus it seemed probable that alien pollen really acted upon the ovary in the cases referred to, and that the popular belief was correct. In confirmation of this view, Professor Gray exhibited several ears of Indian corn, — such as are familiar in the country, — in which two, and even three or four, sorts of grains (such as sweet-corn, yellow and white corn, &c.) occurred intermixed upon the same ear. This appeared to demonstrate an immediate action of the pollen upon the ovary, altering the character of the coat and of the albumen of the grain. This might, or might not, be accompanied by cross-fertilization of the embryo, — a point which it would be interesting to determine by raising plants from the different grains of one ear, guarding them carefully against all extraneous pollen, and noting the character of the resulting grain.

Dr. A. A. Hayes said the fact had been determined by direct experiment ten or twelve years ago, when the question arose whether the same stalk would furnish to each variety upon it its normal quantity of phosphates. It was found that this was the case, and each variety was reproduced the next year from the seed thus raised. At that time he found that all the varieties contain a salt of the peroxide of iron, instead of the protoxide.

Professor W. B. Rogers, referring to the discussion at the previous meeting on the noxious influence of various gases, particularly of carbonic acid and oxide, said, that, although all the recent Continental writers concur in regarding carbonic acid as simply negative in its influence, he had been surprised to find that the most recent English authorities still charge the whole of the pernicious effects of the inhalation of the fumes of burning charcoal to this gas, rather than to the oxide.

Dr. W. F. Channing thought that one source of the injury from breathing impure air was the interruption to the process of endosmose and exosmose, which it was well known was produced by even a slight admixture of carbonic acid.

Professor Rogers suggested that in crowded rooms organic compounds have a good deal to do with the deterioration of the air.

Four hundred and forty-ninth meeting.

March 9, 1858. — MONTHLY MEETING.

The Academy met at the house of the Hon. Josiah Quincy.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from Sir John Herschel, acknowledging the donation of the Academy's Transactions; also one from Mr. Henry T. Parker, offering his services as agent for the purchase of books for the Academy in England.

Professor C. C. Felton, referring to a previous communication of his on a fragment from Menander, remarked as follows: —

"It will be remembered, perhaps, that I made a short communication to the Academy about a year ago, entitled 'Menander in New York.' In that communication an account was given of an ancient Greek writing-tablet in Dr. Abbot's Egyptian Museum, containing a passage of poetry, which, for reasons stated at some length, I supposed to be a hitherto unknown fragment of Menander. It was mentioned, also, that there were other tablets of a similar description, more or less broken, but evidently written over with copies of the passage contained in the first, though apparently by less practised hands. On two of the broken tablets there was substituted for a word in the text another, expressing a ludicrous impatience on the part of the writers, as much as to say, 'Deuce take it.' On re-examining these tablets and fragments of tablets, during a recent visit to New York, I noticed two or three interesting particulars which had before escaped my attention. On one of the fragments is written the following part of a sentence (adding the accents and breathings), ὁ πρῶτος εὖ ποι— ; the rest being obliterated. At the bottom of another tablet is written part of a word, φιλοπον— ; the remainder of this word, also, being obliterated. The first is evidently a portion of a sentence written by the master to encourage the scholars, perhaps by the promise of a reward. The syllable ποι is evidently part of ποιήσων or ποιήσας, and the sentence was, 'He who first shall well perform his work —' The rest must be left to the imagination. The second, φιλοπον—, is part of φιλόπονος or φιλοπόνως, meaning *careful*, or *carefully* or *industriously*, and seems to be an expression of the master's approbation of the manner in which the boy who owned the tablet had written out his copy. We have, therefore, in these tablets, — first, the copy set by the master; second, a sentence of encouragement to the boys; third, the master's approbation of one of them; and, fourth, a lively expression, φθαρήσεται, of the impatience of two of the rogues, who had got tired of the irksome task of writing. From these hints we may form a pretty good idea of a Græco-Egyptian school in the Ptolemaic times.

"Since last winter Dr. Abbott has sent from Egypt three wooden tablets of a different character and a later age. They are elliptical in shape, with a kind of triangular handle at each end. The inscriptions are funereal, recording the names, and in two of them the ages, of the persons whom they commemorate. The first was found in Sacara. On this the inscription is neatly cut into the wood. It is as follows:—

Ανουβιων
Αρτεμιδω-
ρου, ευμοιρει

Anoubion, son of Artemidoros, farewell.

In this inscription it is observable that the name of the deceased is Egyptian, with a Greek termination, while the name of the father is Greek. The name Anoubion occurs in Athanasius. The father of the Anoubion in the inscription was probably a Greek settler, and the son was born in Egypt, perhaps of an Egyptian mother. The form of the letters may belong to the second or third century before Christ.

"The second is from Dongola, and the inscription is written with ink and a reed pen. It is as follows:—

Πληνις νεωτερος
μαρινα εβιωσεν
ετη λε

Plinius the younger, son of Marinas, lived thirty-five years.

Two or three things about this inscription are somewhat remarkable. It is considerably later than the preceding, as is evident from the Roman name Plinius, and from the style of the writing. The name is written in the abbreviated form, Πληνις, which belongs to a comparatively late period. Theodoretus (Lib. II. c. 11) makes mention of a Πλήνιος as an Egyptian Bishop in the fourth century, the age of Athanasius, banished by the Arians, under the influence of George of Cappadocia.

"The name *Marinas* is not found elsewhere, so far as I know; but the form is analogous to *Zosas* (Ζωσᾶς, gen. Ζωσᾶ, which occurs in Boeckh's *Corpus Inscriptionum*) and many others. If the name is feminine, Marina, the syntax is that of the Latin ablative with *natus*, of which there are examples in the *Corpus Inscriptionum* (See Tom. II. p. 850). The name of Marina occurs in the Hagiology of the Oriental Church. She was a native of Pisidia, in Asia Minor, and was beheaded in A. D. 270. In the Ritual of the Greek Church, the 17th of July is given as the anniversary, or feast-day, τῆς ἁγίας μεγαλομάρτυρος Μαρίνης. For this fact, and the reference, I am indebted to my friend and colleague, Mr. E. A. Sophocles.

"The person here mentioned, Plinius, evidently belonged to a Roman, perhaps a Christian family, who had learnt the Greek language in Egypt, but not well enough to avoid Latin idioms, if the last-mentioned construction is the true one.

"The third contains also an inscription written with ink as follows, without accents, like the others. The name Pericles is also written with abbreviated characters.

Περικλης Απολλωνιου εβιωσεν
ετη πεντηκοντα οκτω

Pericles, son of Apollonius, lived fifty-eight years.

Both of the names here are pure Greek, belonging apparently to a family who, though living in Egypt, maintained their Hellenic traditions and Hellenic names unchanged. In the last two of these inscriptions, we observe the ancient euphemistic manner of speaking of death: they do not say that Plinius and Pericles died at such an age, but that they lived so many years.

"I also had time to examine another tablet, different from any of the preceding. It was made of some hard wood, probably cedar, carefully smoothed, about a quarter of an inch in thickness, twelve inches in length, and six in breadth. Across one end three or four lines had been written with a reed pen and Egyptian ink. This writing was to a considerable extent obliterated, — only single letters and isolated syllables remaining legible, but not enough to make out the text. Beneath this was drawn a waving line, to separate it from the writing below, which, on a careful comparison, was evidently a number of copies of the writing at the top, though in an inferior hand. The form of the letters is characteristic of the chirography which prevailed from about the second century before Christ until the fourth or fifth century after; and it may be placed, with a good degree of probability, at least as early as the first century before Christ. The writing at the top of the tablet is, again, evidently that of the schoolmaster, and that which occupies the remainder of the surface, consisting of three entire copies and part of a fourth, is evidently the writing of a scholar. The copies of the scholar are not so much obliterated as the writing of the master, and, on comparing them all, I was able clearly to make out every word of the text. It forms two iambic trimeters, which, supplying the accents, and correcting one word which is misspelt, read as follows: —

ᾧ μὴ δέδωκεν ἡ τύχη κοιμωμένῳ,
μάτην δραμεῖται κἂν ὑπὲρ Λάδαν δράμῃ.

It may be translated:

'The man whom, sleeping, Fortune has not blessed,
Shall run in vain, though Ladas he outran.'

The style of these lines is pointed and pithy; their structure is rhythmically perfect, and the composition undoubtedly belongs to the best age of the new comedy. The Greek word Τύχη does not mean exactly *Chance* or *Fortune*, but rather the secret power which allots to mortals their varied faculties and conditions in life. The thought conveyed in the passage is, that without natural gifts or endowments no great thing can be accomplished. Unless it is *in* a man, achievement, success, cannot come *out* of him. The word misspelled in the copies is δραμιται for δραμεῖται, which shows that when this was written ει and ι were pronounced alike. I assign the composition of the lines to a period much earlier than that to which the handwriting of the copies belongs, but I would not venture to attribute them to any particular poet. Ladas was a Spartan runner who gained the victory in the δολιχὸς δρόμος, or *long race*, and soon afterwards died. The precise period when he lived is nowhere recorded; but as a bronze statue of him, by the sculptor Myron, was well known to the ancients, and as Myron flourished in the fifth century before Christ, Ladas must have gained his victory at least as early as the middle of that century.

"Among the Greek epigrams, there are two in which the name of Ladas is commemorated; both are ἀδέσποτα, or anonymous. The first consists of a hexameter and pentameter, as follows:—

Λάδας τὸ στάδιον εἴθ' ἥλατο εἴτε διέπτη,
Δαιμόνιον τὸ τάχος, οὐδὲ φράσαι δυνατόν.

Whether Ladas leaped or flew through the stadium
It is impossible to say; his speed was divine.

"The second is on the statue of Ladas by Myron. It consists of eight lines, hexameters and pentameters alternately, as follows:—

Οἷος ἔης φεύγων τὸν ὑπήνεμον, ἔμπνοε Λάδα
Θῦμον, ἐπ' ἀκροτάτῳ πνεύματι θεὶς ὄνυχα
Τοῖον ἐχάλκευσεν σὲ Μύρων, ἐπὶ παντὶ χαράξας
Σώματι Πισαίου προσδοκίαν στεφάνου.
Πλήρης ἐλπίδος ἐστὶν, ἄκροις δ' ἐπὶ χείλεσιν ἆσθμα
'Εμφαίνει κοίλων ἔνδοθεν ἐκ λαγόνων.
Πηδήσει τάχα χαλκὸς ἐπὶ στέφος, οὐδὲ καθέξει
'Α βάσις· ὢ τέχνα πνεύματος ὠκυτέρα.

As thou wast, O breathing Ladas, fleeing from the wind swift
Thymus, on the top of the breeze placing thy foot,
Such Myron cast thee in bronze, stamping upon all
Thy body the expectation of the Pisæan crown.
Full of hope is he, and on the tip of his lips the panting breath
Shows itself from the hollow flanks within.
Soon the bronze shall leap for the crown, nor shall withhold it
The pedestal; O art, swifter than the breeze!

"The commentators have found some difficulty in understanding the words ἐπ' ἀκροτάτῳ πνεύματι θεὶς ὄνυχα, 'placing thy foot upon the top of the breeze'; but they describe exactly the attitude of John of Bologna's Mercury, a well-known work of art, which furnishes the best commentary on the passage in question.

"Among the Roman poets Ladas is alluded to once by Catullus, twice by Martial, and once by Juvenal; Pausanius, the Greek traveller, mentions him three times. In Lib. ii. 19. 7, he speaks of a statue of Ladas in the temple of Lycian Apollo at Argos; in Lib. iii. 21. 1, he mentions the monument of Ladas on the bank of the Eurotas, a short distance out of Sparta; and in Lib. viii. 12. 3, he states that on the road leading from Mantinea to Orchomenos, there was a place called the stadium of Ladas, because Ladas used to exercise himself there as a preparation for the Olympic games."

Rev. N. L. Frothingham said: —

"It is with great diffidence that I venture to add anything to what my learned friend has just offered to the notice of the Academy. But I am very much struck with the coincidence of thought between the fine passage which he has restored to Greek literature and a verse in one of the Hebrew Psalms. That verse is rendered so incorrectly in our received English translation, that the parallelism does not appear. But it will be brought out, if we read the whole context thus, as it ought to be read: 'Except the Lord build the house, they labor in vain that build it; except the Lord keep the city, the watchman waketh but in vain; in vain for *you* to rise up early, to sit up late, to eat the bread of anxiety, while he giveth to his beloved when they are asleep.' Now, if, instead of the word Fortune, — Τύχη I think it is in the Greek sentence, — we should substitute some such expression as Divine Providence, the sentiment would correspond perfectly with that of the sacred Psalmist. Exchange the heathen phrase for a Biblical one, and there results the same thought; and a very profound and noble thought it seems to me to be."

Mr. Charles Folsom referred to the fact, that tablets similar in form to that described by Professor Felton are still in use, in Northern Africa, for the same purpose.

Mr. Folsom also alluded to the inscription which he had laid before the Academy at the previous meeting, and announced his acceptance of Professor H. W. Torrey's version, by which the obscurity and inelegance of the inscription are removed.

The President said he was induced, by the discussion on some of the terms in the inscription, to allude to a point which had often occurred to him, namely, the impropriety of the use of the word *Respublica* in the Catalogue and Diplomas of Harvard University; and he proceeded to show that classical usage does not sanction the application of this word in a geographical sense, as is the case in the instances above mentioned.

Professor E. N. Horsford exhibited a number of photographs of a piece of recent ice, by which its intimate structure was very accurately shown.

Mr. Henck gave a demonstration of a general theorem, which he believed to be new, relating to circles tangent to each other and to two given circles, — the given circles being also tangent to each other. This theorem embraced as particular cases the two remarkable propositions concerning similar circles given by Pappus Alexandrinus in the fourth book of his Mathematical Collections. In the course of the demonstration, several interesting properties were developed, some of which he thought had been hitherto unnoticed.

Dr. A. A. Hayes made a communication "On the Corrosion of Yellow-Metal Sheathing, in Sea-water," as follows: —

"In some earlier researches on the chemical and mechanical constitution of alloys, I have demonstrated the existence of several definite compounds of two metals, or one metal with a metalloid, united to form a ductile body.

"The chemical analysis, by the *proximate way*, of yellow-metal, has shown that, when it is formed from pure copper and pure zinc, there exist *two* distinct alloys. One of these is the well-known alloy of two equivalents of copper, united to one equivalent of zinc; the other is composed of one equivalent of each of these metals, in chemical union. A mass of yellow-metal presents, therefore, a crystalline aggregate of two alloys, in which the *percentage* proportion of copper is sixty, while the zinc has the proportion of forty; and analysis having in view the percentage of these metals only, gives usually nearly these quantities.

"As the relation of zinc to oxygen differs remarkably from that of copper, it might have been inferred that an alloy composed of one equivalent of copper and one equivalent of zinc would also have a different relation to oxygen, when compared with one that contains two equivalents of copper. Considering sea-water action simply as oxidation, under the most favorable conditions for combination without the application of artificial heat, the study of the corrosion of yellow-metal under exposure offers a simple and unobjectionable course for obtaining trustworthy facts.

"It is well known that this yellow alloy, when carefully secured on sailing-vessels, quickly exhibits marks of corrosive action when more or less immersed in sea-water. The rapidity of this action diminishes after the formation of a certain proportion of oxide, which, slightly mixed with chlorides, serves as a protecting surface to the metal below, by close adhesion. A serviceable duration of thirty-six to forty-eight months is expected, in sheets of ordinary thickness.

"The specimens which accompany this paper are parts of sheets which have been exposed nearly forty-eight months. In the one which represents the alloy in the condition it was in when it was placed on the vessel, at one part, analysis shows a percentage composition — neglecting traces of lead and other metals — of copper 60, zinc 40.

"Another specimen, which has been corroded deeply, exhibits to the naked eye a mechanical structure unlike that of the first piece: it retains only part of its original ductility, and this unequally. Crystalline particles are seen, and, even in the interior of the mass, oxygen has penetrated, and combined with the metals. The composition of this piece is, copper 63.6, zinc 33.9, oxygen 2.0, lead and other metals, 0.5 = 100.

"In the third piece, which is a part of the last, corrosion has proceeded to the extent of destroying cohesion nearly: the particles remain attached only through an interlacing of contiguous parts, separating at once when the sheet is doubled, or beaten into crystalline grains, coated by a thin layer of oxide. By the chemical action the composition of this piece has undergone a great change, and analysis gives the percentage of copper 74.5, zinc 22.8, oxygen 2.1, lead 0.6 = 100.

"At several points deep cavities, and in many sheets holes, exist; these have been caused by the corrosion around grains of slag, which had been rolled into the mass of the metal. In such cases the slag is a negative body to the surrounding metal, *after corrosion commences,* and an increased power of action is thus gained, locally. Carefully conducted experiments prove the correctness of the theoretical deduction, that the alloy represented by copper, two equivalents, and zinc, one equivalent, has an inherent negatively electrical condition, when compared with the alloy of one equivalent of copper and one equivalent of zinc; and this state has been found in the cleaned parts remaining of sheets which have suffered the largest amount of corrosion.

"But the chemical evidence which we thus obtain of the abstraction of the most positive alloy by sea-water action, is not more interesting than that of a physical character. Every piece which has been disintegrated presents highly crystalline — almost regularly crystallized — assemblages of the alloy of two equivalents of copper to one equivalent of zinc, as its mass.

"Now, in the ductile metal before exposure, we detect the facets of these crystals of this alloy, which might be mistaken for those found in many laminated pure metals, while the chemical action, being confined to the most positive alloy, brings them more and more distinctly to view, enabling us to prove that these large masses of metal, in corroding, divide mechanically, as well as chemically, into two pre-existing alloys; one oxidizing and being washed away, while the other, nearly pure, remains coherent to some extent.

"It had been long known that the corroded metal, when about to be re-manufactured, called for the addition of zinc, in order to form the normal alloy; the facts here stated prove that the abstraction of the larger proportion of zinc arises from the removal of the most positive of two alloys, which were united in the perfect metal as a homogeneous mass.

"As multiplied observations have shown that the merchant service requires *a certain continuous solution of the sheathing metal*, in view of the present enormous consumption, this subject has economical bearings of great importance. It is probable that an alloy, forming part of a mixed metal, might be found, less positive in its relation than the one removed from yellow-metal, and yet sufficiently oxidizable to preserve the surface clean while the vessel is in motion. Such an alloy united to brass would present the mechanical requirements, in union with a chemical resistance called for, in sheathing metals."

Professor W. B. Rogers gave an account of his experiments on the production of sounds by flames within glass tubes, and explained the principle of their formation.

Professor Felton alluded to the newly discovered process of Photo-lithography, which had been announced to the Academy by Dr. W. F. Channing at the previous meeting, and suggested that it offered an admirable method for the reproduction of the inscription on an ancient papyrus in Dr. Abbot's Egyptian collection. He had spoken to the inventors of the process, and the plan of reproducing it in this way seemed to them quite practicable. If it could be done, this would be the second inscription of that kind which had ever been published.

Dr. Channing said he had no doubt the inscription could be lithographed by this process at a moderate cost, and moved that the Publishing Committee take into consideration the expediency of thus bringing before the scientific world this interesting papyrus. The motion was seconded by Professor Felton, and adopted. Dr. Channing was added to the committee for this purpose.

Four hundred and fiftieth meeting.

April 13, 1858. — MONTHLY MEETING.

The Academy met at the house of Hon. C. F. Adams.

The PRESIDENT in the chair.

A letter was read from Mr. John Akhurst, of Brooklyn, N. Y., dated March 30, offering to forward to the Academy certain publications of European Societies, addressed to the Academy, which had come into his possession at a custom-house sale, on payment of certain charges. Also a letter from the Librarian of the University Library, Cambridge, England, February 3, 1858, acknowledging the receipt of the Academy's publications.

Professor Lovering, for the Committee on Meteorological Observations, read the following report: —

"At a meeting of the Academy on the 27th of May, 1856, Dr. B. A. Gould, Jr. offered some remarks on the difficulties which meteorologists (particularly in Europe) find in obtaining meteorological observations made in Boston and its vicinity. Whereupon it was voted that Professor D. Treadwell, Professor Lovering, and Mr. Jonathan Hall be a committee to take the subject into consideration. During the long period which has elapsed since their appointment, this committee have not lost sight of this subject. After carefully examining the materials at their disposal, they have begun with the publication of Mr. Jonathan Hall's observations on the thermometer, made at No. 51 Hancock Street, Boston, since January 1, 1821. These observations, made three times a day, with scarcely a single interruption, and continued down to the present time, have been published for a period of thirty-six years, ending with January 1, 1857; together with observations on the quantity of rain which has fallen since 1823, or during a period of thirty-four years. This publication fills eighty of the quarto pages of the Memoirs, and terminates with tables which show the mean heat of each year, and the mean heat of each month, for thirty-six years; also, the mean heat of the whole period: the same *means* also for the three particular hours of the day at which the observations were taken.

"The committee propose, with the approbation of the Academy, to publish next the meteorological observations of the late Dr. Enoch Hale. Dr. Hale's observations on the thermometer, winds, and clouds began January 1, 1818, and ended December 31, 1848, covering a period of thirty-one years. His observations on the barometer began December 1, 1818, and ended December 13, 1848, extending over a period of thirty years and a few days. The publication of these observations is due, not only to the cause of science, but also to the memory of Dr. Hale, who was recognized by the Academy as its meteorological observer, and who was encouraged to continue and improve his observations by its aid and advice."

On motion of Professor Gray, it was voted that the report be accepted, and that the committee be requested to continue their labors.

On motion of Mr. G. B. Emerson, it was voted that the subject of the preservation of the meteorological papers of the Academy be referred to the same committee.

The Publishing Committee, to whom had been referred the subject of publishing a photo-lithographic copy of the papyrus in Dr. Abbot's Egyptian Museum, reported progress, giving details of the probable extent and expense of the work. Professor Lovering stated that it was Professor Felton's wish that the publication might be postponed, as he expected to be absent from the country during the coming summer.

Professor W. B. Rogers addressed the Academy on the efflux of gases from a cylindrical orifice. He stated that the fluid escaped in the form of rings, each section of the ring revolving in its own plane.

Professor Jeffries Wyman referred to certain experiments he had made, to ascertain the nature of the impression made by falling masses of water on plastic clay. He found that, in falling, the drops became rings, the section revolving inwards and upwards in its own plane, as indicated by the impression in the clay, its inner edge being higher than the outer, and marked by converging lines.

Professor Rogers explained the method by which this phenomenon resulted, as he thought, from the mechanical forces called into operation.

Professor Gray then presented the following communication: —

Notes upon some Rubiaceæ, collected in the United States South-Sea Exploring Expedition under Captain Wilkes, with Characters of New Species, &c.

1. *Timonius, Bobea, and some other Guettardeæ.*

These two genera were confused by De Candolle, and have not been satisfactorily cleared up by Korthals, who occupied himself with them several years ago, nor by Miquel, who, in his Flora of Netherlands

India, has followed Korthals' steps. For the information which enables me to fix their synonymy, and give their true characters, I am indebted to the Nestor of our science, Robert Brown. Nearly half a century ago, this most sagacious and conscientious botanist had identified with *Timonius* of Rumphius a plant collected by Sir Joseph Banks at Endeavor River, and by himself on the same coast of tropical Australia; and in the Banksian herbarium he had referred the *Erithalis* of Forster (not of Linnæus) to the same genus. An allied plant of the Sandwich Islands (the type of Gaudichaud's genus *Bobea*) was also known to Mr. Brown, and suspected to be not congeneric with *Timonius*.

Desfontaines, in the year 1820, established his genus *Polyphragmon* upon the original *Timonius*.

In 1829, Chamisso and Schlechtendal published in the Linnæa their genus *Burneya*, founding it upon Forster's *Erithalis*, and adding the Sandwich Island plant, with some doubt, as a second species.

Still earlier, however, Gaudichaud had issued his plate of the latter plant, founding on it his genus *Bobea;* but his volume of letter-press, although it bears the date of 1826, was not published until 1830.

In that year De Candolle published the fourth volume of the Prodromus. Adopting, in place of *Burneya*, the name of *Timonius*, — probably from the Banksian herbarium, — he followed Chamisso and Schlectendal in referring the Sandwich Island plant and Forster's *Erithalis* to the same genus, but took the carpological characters wholly from the former. That he had no idea of the fruit of the latter, and that he had not in fact recognized the *Timonius* of Rumphius, appears from his having referred the fruit of Forster's plant, as figured by the younger Gærtner, to another genus, viz. the *Polyphragmon* of Desfontaines, which is pretty clearly the original *Timonius*.

More recently (in 1849?) Korthals undertook to elucidate these plants. But he wrongly describes the internal structure of the seed; he refers the original *Timonius* to *Polyphragmon*, instead of *Polyphragmon* to it; he divides congeneric species between his *Bobea* and *Polyphragmon*; and, finally, he had not the means of knowing the leading character of Gaudichaud's genus *Bobea*, i. e. the imbricative æstivation of the corolla.

Lastly, Miquel follows Korthals implicitly; but in his addenda to *Rubiaceæ* (Fl. Ind. Bat. 2, p. 355), he states that the fruit of *Bobea* is the same in structure as *Polyphragmon*. Still the fact that the fruit of the original *Bobea* is figured and described quite otherwise does not arrest his attention nor suggest the true state of the case.

Korthals should have the credit of rightly making out the character of the singular plug which occupies the summit of the pyrenæ of the fruit in these plants; but he apparently was not aware that A. Richard had remarked the same thing in *Guettarda*, and rightly understood it. It is, in fact, a general Guettardæous character, as also is the exalbuminous seed, now first made known.

The amended characters, and the synonymy of the two genera in question, are subjoined, with the diagnoses of some new species.

TIMONIUS, *Rumph.*

Flores polygami. Calycis limbus cupuliformis persistens. Corolla hypocraterimorpha, intus nuda, lobis 4–10 æstivatione valvatis. Stamina tubo inserta; filamentis brevissimis. Stylus apice 5–10-fidus, lobis subulatis inæqualibus intus stigmatosis. Ovarium pluriseriatim multiloculare. Ovula in loculis solitaria, funiculo brevissimo cupuliformi suspensa. Drupa polypyrena; pyrenis numerosissimis angustis circa axim elongatam imbricatim et multiseriatim superpositis, putamine apice pervio funiculo seminis strophiolæformi (obturamenti suberosi instar) clauso. Semen lineare vel oblongum: albumen vix ullum. Embryo semini conformis, cylindricus; cotyledonibus radicula multo brevioribus. — Arbores vel frutices, stipulis interpetiolaribus perulatis vernatione convolutis mox caducis; foliis coriaceis, venulis (pagina superiore præsertim) sæpius tenuissime et creberrime reticulatis; pedunculis axillaribus uni–plurifloris.

Timonius *Rumph. Herb. Amboin.* 3, *p.* 216, *t.* 140; *R. Brown in Herb. Banks & Mss. Ann.* 1810.
Porocarpus, *Gœrtn. Fruct.* 2, *p.* 473, *t.* 178.
Erithalis, *Forst. Prodr.; Gærtn. f. Suppl. p.* 92, *t.* 196, non *Linn.*
Polyphragmon, *Desf. in Mem. Mus. Par.* 6, *p.* 6, *t.* 2; *A. Rich. Mem. Rub. p.* 151.
Burneya, *Cham. & Schlecht. in Linnæa*, 4, *p.* 189, excl. sp. *No.* 2.
Timonius (excl. sp. & char.) & Polyphragmon, *DC. Prodr.* 4, *p.* 445, 461.
Bobea (excl. syn. Gaud.) & Polyphragmon, *Korthals in Neder. Kruidk. Arch.* 2, *p.* 212, 215; *Miquel, Fl. Ind. Bat.* 2, *p.* 234, 260.

Timonius Forsteri, *DC. l. c.* Erithalis polygama, *Forst.* E. uniflora, *Banks; Gærtn. f.* Burneya Forsteri, *Cham. & Schlecht. l. c.* Polyphragmon minus, *A. Rich. l. c.; DC. l. c.* Bobea Forsteri & B. Gærtneri, *Korthals, l. c.* — South Sea Islands.

Timonius sapotæfolius (*Gray, in Bot. Pacif. Expl. Exped. ined.*): foliis etiam nascentibus cum stipulis majusculis ramulisque glaberrimis elliptico-oblongis utrinque acuminatis venulis creberrimis lineato reticulatis quasi tenuiter nervoso-striatis, areolis lineari-elongatis parallelis, venis primariis obsoletis; pedunculis fructiferis petiolum æquantibus; pyrenis linearibus, putamine tenui. — Feejee Islands.

Timonius affinis (*Gray, l. c. ined.*): foliis ovalibus obscure penniveniis, venis subreticulatis, retibus venularum varie versis hinc inde contrariis; — cæterum præcedentis. — Feejee Islands.

BOBEA, *Gaudichaud.*

Flores hermaphroditi (an semper?). Calycis limbus cupuliformis persistens. Corolla hypocraterimorpha, glabra, intus nuda, lobis 4 ovalibus obtusissimis æstivatione valde imbricatis. Stamina tubo inserta; filamentis brevibus. Stylus superne inæqualiter 3–10-fidus, lobis filiformibus apice introrsum stigmatosis. Ovarium 3–10-loculare. Ovula in loculis solitaria, funiculo brevissimo strophiolæformi suspensa. Drupa 3–10-pyrena; pyrenis parallelis osseis crassis, sarcocarpio tenui. Semen cylindricum, cum funiculo strophiolato crassissimo duro (instar obturamenti) eodem latius loculum angustum implens: albumen vix ullum. Embryo semini conformis; radicula oblonga cylindrica; cotyledonibus brevibus subcomplanatis. — Arbores Sandwicenses; stipulis squamaceis interpetiolaribus discretis caducis; venulis foliorum creberrime ac tenuissime reticulatis; pedunculis uni–paucifloris.

Bobea, *Gaudich. in Bot. Voy. Freyc, p.* 473, *t.* 93, non *Korthals.*
Bobæa, *A. Rich. Mem. Rubiac. p.* 135.
Burneyæ sp. No. 2, *Cham. & Schlecht. in Linnæa, l. c.*
Timonius, *DC. Prodr.* 4, *p.* 461 ex char., non *Rumph.*

1. Bobea elatior (*Gaudich. l. c.*): glaberrima; foliis obovatis oblongisve basi in petiolum sat longum attenuatis; pedunculis gracilibus 3–7-floris, flore intermedio sessili, omnibus basi subcupulatis. — Oahu, Sandwich Islands.

2. Bobea brevipes (*Gray in Bot. Expl. Exped. ined.*): foliis oblongis vel subovatis breviter petiolatis, junioribus præsertim ramisque hirto-pubescentibus, pedunculis brevibus unifloris? — Oahu, Sandwich Islands.

The name of *Bobea* is to be preferred to *Burneya*, not only because Gaudichaud's plate was earliest published, but because Chamisso's genus was founded primarily upon Forster's *Erithalis*, which is a genuine *Timonius*.

The æstivation of the corolla (now first made out), the completely hermaphrodite blossoms, as far as is known, and the uniseriate, comparatively few, and very thick-walled pyrenæ, amply distinguish *Bobea* from *Timonius*. From the æstivation, the two genera would fall into different subtribes, if we implicitly follow the distribution of the *Coffeææ* suggested by Mr. Bentham, who, in the Niger Flora, and in the Kew Journal of Botany, has brought out, with his usual sagacity, the best characters for a natural arrangement of the *Rubiaceæ*. *Timonius*, with valvate æstivation, would fall into his *Vanguerieæ*, and *Bobea* into his *Guettardeæ*. But characters from the æstivation of the corolla, convenient and generally reliable as they are, must in this, as in many other cases, give way to other considerations. And the close similarity of these two genera in most other respects, especially in their nearly exalbuminous embryo, the plug-shaped funiculus filling the upper part of the cell, as also the delicate venular meshes of the leaves (of which traces occur in most *Chomeliæ* and *Guettardæ*), plainly requires us to refer *Timonius* also to the *Guettardeæ*. This is well confirmed by Wight and Arnott's genus *Eupyrena*, which is exactly intermediate between *Timonius* and *Bobea*, having the corolla, &c. of the former, and the ovary and fruit of the latter.* A leading character of the *Guettardeæ*, as I should define the group, has escaped general notice, namely, the wholly or nearly exalbuminous embryo, the embryo being a macropodous radicle with small and obscurely-marked cotyledons occupying merely the lower extremity. This, as well as the true pericarpic direction of the embryo, however, was rightly understood by Gærtner, in *Guettarda speciosa*. What A. Richard calls a thin fleshy albumen in this plant, is apparently the tegmen of the seed; and what he took for the radicular extremity of the embryo ("cet embryon est dressé") is the cotyledonar end. The mistake is the more remarkable on Richard's part, since he had recognized the crustaceous plug at the summit of the cell as the funiculus. Otherwise, the tapering of the ovule and young seed to an acute apex at the base of the cell might readily lead one to regard them as attached there, and may have given origin to the character "semina erecta," assigned by De Candolle and others, and which even Miquel leaves in the generic character (with a mark of doubt), although, following Bentham, he rightly defines the

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* The fruits of *Eupyrena*, with which I have been supplied by Dr. Hooker and Dr. Harvey, do not furnish sound seeds; but I have no doubt that these are exalbuminous or nearly so. The ovary is sometimes only quinquelocular; and the ovules are suspended. "Semina erecta" is a phrase wrongly introduced into the generic character by Endlicher.

Guettardeæ as having pendulous (more correctly, suspended) ovules. In *G. elliptica*, the only other species of the genus which I have with mature fruit, the embryo is similar to that of *G. speciosa*. The cotyledons, although difficult to separate in the mature seed, are plainly discernible in rather unripe ones; they are very short, oval, thin, and of no greater diameter than the radicle at that end.

That the seed of *Timonius* is exalbuminous had been long ago ascertained by Mr. Brown, who directed my attention to the fact.

The occasional absence of albumen in this family is not very surprising. Those systematists who regard the difference between a deposit of nourishing matter *around the embryo* and *in the embryo* as one of very high taxonomic importance, should consider how large is the number of natural orders in which the two modes are now known to coexist.

From the indications now given, the true *Guettardeæ* may be characterized as follows: —

Subtr. GUETTARDEÆ. Corollæ lobi æstivatione imbricati, raro valvati. Ovarium bi-multiloculare: ovula in loculis solitaria suspensa. Drupa bi-plurilocularis vel di-pleiopyrena. Semina e funiculo crasso obturamentiformi appensa: albumen nullum vel parcum. Radicula longa: cotyledones parvi.

We have a new Guettardæous plant, possibly a *Guettarda*, from the Feejee Islands, of which blossoms are wanting for the determination of the genus. Of the following, we possess rather better materials, but still the genus is uncertain.

CHOMELIA? SANDWICENSIS (*Gray, in Expl. Exped. ined.*): ramis junioribus pubescentibus; foliis glaberrimis oblongo-ovatis acuminatis basi rotundatis; fructu dipyreno globoso calycis lobis majusculis ovalibus obtusissimis recurvis coronato. — Oahu, Sandwich Islands.

When better known, this may prove to be a new generic type. But it is more likely to fall into *Chomelia*, or else into *Guettardella* of Bentham, which is hardly sufficiently distinguished by the more numerous ovarian cells. *Chomelia ribesioides*, Benth., occasionally exhibits a 4-celled putamen, and the pyrenæ of *Guettardella Chinensis* are frequently consolidated in the same manner; — just as in *Arctostaphylos*, in which the pyrenæ are either discrete or variously concrete in the same species. The veinlets of the leaves, especially of the upper surface, form minute and elegant transverse reticulations. The fruit is that of a *Bobea* reduced to two pyrenæ; the seed has a similar plug-like funiculus; the embryo is invested by a very thin layer of albumen; its lower extremity bears a pair of very minute and thin cotyledons.

2. *Canthium and the Vanguerieæ.*

Canthium, § Tarotea. Corolla hypocraterimorpha, tubo lobis duplo longiore: antheræ subsessiles, mucronatæ.

To this section, designated by one of the aboriginal names of the Tahitian species, as recorded by Forster, belongs *Chiococca barbata* of Forster, which Mr. Bentham (in the Niger Flora) has already referred to *Canthium*, and the following closely related species: —

Canthium sessilifolium (*Gray in Expl. Exped. ined.*): inerme, glabrum; foliis oblongo-ovatis seu ovato-lanceolatis basi rotundata fere sessilibus chartaceis supra lucidis; pedicellis solitariis binis ternisve in axillis flore gracili (semipollicari) dimidio brevioribus; pedunculo communi vix ullo; limbo calycis 5-dentato; pyrenis seminibusque fere rectis angustis. — Vanua-levu, Feejee Islands.

To the character of Bentham's subtribe *Vanguerieæ*, it will be necessary to add, that the seeds have a copious albumen and well-developed cotyledons. In *Canthium*, the ovules are only *pendulous*, and sometimes semi-anatropous, or nearly so. *Morinda* was referred to this group by Mr. Bentham, through some oversight.

3. *Ixoreæ.*

These are well characterized by the *convolute* æstivation of the corolla and the peltate or centrally affixed ovules. Miquel incorrectly characterizes the group (his tribe *Pavetteæ*) as having the lobes of the corolla *imbricated* in æstivation, whereas they are most obviously convolute, as Mr. Bentham distinctly stated in his note, explaining that he used the word *imbricated* in a general sense for all overlapping forms. The more definite term (convolute) would have obviated misapprehension, and would be strictly correct, so far as is known.

To unite *Ixora* and *Pavetta*, as Richard, Blume, and Miquel have done, seems not unnatural. But the former name ought in that case to be retained, not only because it had been preferred by Lamarck, but because, as a Linnæan genus, it is ten years older than *Pavetta*, appearing as it does in the first edition of the Genera Plantarum.

The collection which forms the basis of these remarks comprises one genuine South American *Ixora*, and three undescribed Oceanic species, which, along with *I. fragrans* (*Cephaelis fragrans*, Hook. & Arn. Bot.

Beech., p. 64, t. 13), constitute a marked section of the genus (*Phylleilema*), on account of a pair of bracteant leaves forming a diphyllous involucre to a cluster of three or more sessile flowers.

IXORA ERIANTHA (*Gray, in Expl. Exped. ined.*): stipulis aristato-subulatis; foliis ovalibus ovatisque obtuse subacuminatis subsessilibus basi rotundatis vel subcordatis ramisque glabris; cyma parva terminali floribusque subsessilibus; corolla extus cum calyce pubescente, lobis ovato-lanceolatis acutis tubo suo gracillimo triplo brevioribus. — Brazil, near Rio Janeiro. — Aff. *I. Bahiensi* et *I. Schomburgkianæ*, Benth.

IXORA (PHYLLEILEMA) SAMOENSIS (*Gray, l. c.*): glaberrima; foliis ovalibus utrinque obtusis vel obtusiusculis, floralibus etiam petiolatis ovatis capitulum triflorum fulcrantibus; dentibus calycis subulatis; corolla glabra; stipulis longissime aristato-subulatis. — Upolu, Samoan Islands.

IXORA (PHYLLEILEMA) VITIENSIS (*Gray, l. c.*): glaberrima; foliis ovato-oblongis acuminatis basi rotundatis, floralibus seu bracteis late cordatis arcte sessilibus capitulum triflorum fulcrantibus; dentibus calycis brevissimis; corolla glabra; stipulis longissime aristatis. — Ovolau, Feejee Islands.

IXORA (PHYLLEILEMA) AMPLIFOLIA (*Gray, l. c.*): foliis elongato-oblongis subacuminatis basi obtusissimis subcordatisve glabris, floralibus bracteisve ovalibus arcte sessilibus capitulum plurifiorum fulcrantibus; dentibus calycis brevissimis; corolla cum ovario extus pubera; stipulis breviter subulato-aristatis. — Samoan Islands.

4. *Morindeæ.*

Through some oversight, Bentham, in the Niger Flora, mentions the *Morindeæ* as belonging to his subtribe *Vanguerieæ*. Miquel, in his recent Flora of the Dutch East Indies, adopting this view without examination, introduces the phrase "ovulis pendulis" into the characters of his tribe *Morindeæ* and of the genus *Morinda*, and alters that of *Tribrachya*, Korthals, in conformity with that view. Yet he (rightly enough) reduces *Sphærophora* of Blume to *Morinda*, although Blume's analyses represent anatropous erect ovules. An examination of the flowers of some *Morinda*, so obviously demanded by this patent discrepancy, would have shown the micropyle of the ovule, and in fruit the radicle, to be inferior. In some species, as in *M. citrifolia*, the ovule is fixed by near its middle; in others, nearer the micropyle, — in some so close to it that the ovule is truly anatropous and ascending or nearly erect, thus invalidating Korthals' *Rennellia* as well as his *Tribrachya*. In the arrangement of the *Coffeæ*, therefore, it would seem best to take the concretion of the flowers into account, and to regard *Morinda* as the type of a distinct subtribe, in other respects intermediate between the *Ixoreæ* and the *Psychotrieæ*.

Besides a rather doubtful variety of *Morinda umbellata* (which includes *M. tetrandra* of Jack) from Tahiti, we have the following new Oceanic species: —

Morinda myrtifolia (*Gray, l. c.*): glaberrima; ramis gracilibus scandentibus; stipulis in vaginam truncatam brevem connatis, foliis sublonge petiolatis subcoriaceis nitidulis lanceolato- seu elliptico-oblongis obtusis nunc obtuse acuminatis, venis primariis haud conspicuis axillis nudis; pedunculis terminalibus brevibus solitariis 2 – 4-nisve; capitulis plurifloris globosis; tubo corollæ 4-fidæ intus villoso-barbato. — Feejee Islands. — The ovule or seed in this and in *M. mollis* is semi-anatropal; in the two others, anatropal, and from near the base of the cell: radicle inferior.

Morinda lucida (*Gray, l. c.*): glabra, scandens; stipulis in vaginam brevem connatis, summis utrinque 1 – 2-cuspidatis; foliis ovatis et oblongo-lanceolatis acuminatis chartaceis supra lucidis venulis reticulatis, subtus opacis, venis primariis tantum perspicuis in axillis sæpius barbellatis; pedunculis (fructiferis) solitariis ternisve terminalibus petiolos adæquantibus; capitulis plurifloris; syncarpio globoso pollicari. — Feejee Islands.

Morinda mollis (*Gray, l. c.*): scandens, undique velutino-pubescens; foliis membranaceis ovato- seu obovato-oblongis caudato-acuminatis basi sinu parvo subcordatis perspicue penniveniis; pedunculis plurimis in umbella terminali; capitulis plurifloris; syncarpio globoso pubescente. — Feejee Islands.

Morinda bucidæfolia (*Gray, l. c.*): glabra, scandens; stipulis subdistinctis; foliis obovato-cuneatis obtusis vel retusis coriaceis supra nitidulis subtus venulis inter costas rectas prominulas crebre reticulatis; pedunculis plurimis terminalibus; capitulo globoso 7 – 10-floro. — Feejee Islands.

5. *Psychotrieæ.*

The novelties of the collection belong to *Myrmecodia*, *Hydnophytum*, *Straussia* (*Coffea*, § *Straussia*, DC.), to the large genus *Psychotria*, to *Chasalia*, and to a new genus of *Psychotrieæ* (including *Cephaelideæ*), remarkable for the greatly-developed and corolliform limb of the calyx.

Myrmecodia imberbis (*Gray in Expl. Exped. ined.*): inermis; foliis lanceolato- seu spathulato-oblongis; corolla tubulosa intus nuda glaberrima calyce cum ovario quadruplo longiore; stylo simplicissimo; stigmate quadri-apiculato indusio lanato-ciliato cincto; fructu (in sicco) obpyramidato quadrilobo, pyrenis 4 corneis. — Feejee Islands. — Parasitic, or pseudo-parasitic, on trees, in the manner of its allies, by a dilated tuberous base, cavernous within. Corolla thickish, half an inch in length, tubular, 4-cleft, perfectly glabrous and naked within and without, and destitute of scales, beard, or other appendages in the throat.

There is no small obscurity about the one or two old species of this genus, and respecting the distinction between it and *Hydnophytum*, which the Dutch botanists ought to clear up. But the present species — notwithstanding that the corolla wants the beard described by Jack, and the fornicate scales mentioned by Blume — is undoubtedly a genuine member of Jack's genus *Myrmecodia;* and its stigma is probably similar to the "*stigma simplex tomentosum*" of *M. tuberosa.* But this stigma in our plant consists of four minute apiculate lobes, terminating a filiform entire style, and surrounded by a kind of indusiate margin which is fringed by a circle of delicate arachnoid hairs. — From the analyses I should refer Gaudichaud's *M. inermis* and *M. echinata* to *Hydnophytum.*

Hydnophytum longiflorum (*Gray, l. c.*): foliis elongato-oblongis; corolla gracillima (semipollicari) intus glabra, tubo lobis oblongis pluries longiore; stigmatibus 2 petaloideis reniformibus; drupa dipyrena. — Feejee Islands.

The one or two dubious Coffeas of Chamisso, from the Sandwich Islands, are not particularly related to *Coffea* (which, although strangely left in the *Psychotrieæ* by Miquel, contrary to the assigned characters, had already been well defined by Bentham as having "the æstivation and placentation of *Ixora* and *Pavetta*, with an axillary inflorescence and a peculiar seed"), but are near to *Chasalia*, from which they are distinguished by the short corolla and the scarcely meniscoidal seed. Nuttall has indicated these plants, in the Hookerian herbarium, as a new genus, *Apionema;* but his name must give place to De Candolle's long-published sectional name of

STRAUSSIA.

Calyx tubo turbinato; limbo cupuliformi truncato vel repando brevi. Corolla brevis, 4 – 5-fidi; lobis tubo æquilongis seu longioribus æstivatione valvatis. Stamina 4–5, fauci inserta: filamenta brevia: antheræ oblongæ, basifixæ. Stylus filiformis: stigmata 2 subdilatata. Ovarium biloculare. Ovula in loculis solitaria, e basi erecta, anatropa. Drupa sæpius pyriformis, dipyrena; pyrenis chartaceis vel tenuiter cartilagineis plano-convexis lævibus. Semen plano-convexum seu leviter meniscoideum, testa tenui adhærente: albumen corneum, ventre sulco profundo clauso exaratum, interne fissuratum. Embryo parvus *Coffeæ* vel *Psychotrieæ.* — Arbores aut frutices Sandwicenses; stipulis interpetiolaribus subconnatis obtusis mox deciduis; cyma terminali multiflora longe pedunculata; floribus parvis.

Straussia Kaduana: foliis subsessilibus cuneato-obovatis, junioribus subtus ad costas cum pedicellis calycibusque sæpissime ferrugineo-pilosulis; corollæ fauce imberbi; drupa pyriformi subquadrangulata. Coffea Kaduana, *Cham. & Schlect. in Linnæa,* 4, *p.* 33; *DC. Prodr.* 4, *p.* 502; *Hook. & Arn. Bot. Beech. p.* 86; *Walp. in Rel. Meyen. p.* 352. Apionema obovata & A. penduliflora, *Nutt. in Herb. Hook.* — Oahu, Sandwich Islands. — The thin fissure in the axis of the albumen is symmetrical, not lined with a membrane, and not owing to an infolding, like that of a coffee-grain. — It is questionable whether the throat of the corolla is always naked, and whether the second species is distinct from the present. The five bearded spots certainly exist in the *Coffea Chamissonis* of Hooker and Arnott, although they were overlooked (they are never so conspicuous as would be inferred from Chamisso's description); hence that is to be referred to

Straussia Mariniana: tota vel fere glabra; foliis breviter seu brevissime petiolatis obovato-oblongis ellipticisve; corollæ fauce inter stamina breviter barbata; drupa obovato-pyriformi. Coffea Mariniana, *Cham. & Schlect. l. c.; DC. l. c.* C. Chamissonis, *Hook. & Arn.* Apionema sulcata, *Nutt. in Herb. Hook.* — Oahu, Sandwich Islands.

Straussia Hawaiensis (sp. nov.): foliis longius petiolatis obovatis calycibusque glaberrimis; corollæ fauce inter stamina barbata; drupa parva ovoidea vel obovata. — Hawaii, Sandwich Islands. — The conspicuously petioled and usually large leaves, and the small fruit (only three, instead of six or seven, lines in length), distinguish this species from the preceding.

The following species of *Chasalia* approach *Psychotria.*

Chasalia Amicorum (*Gray, l. c.*): glaberrima; stipulis vaginantibus; foliis oblongis ovalibusque basi acutis, venis primariis 6–8; cyma laxiflora breviter pedunculata; calycis tubo ultra ovarium obovatum producto et in limbum crateriformem subquadridentatum abrupte expanso; fructu obovato; pyrenis 2 apice subtridentatis dorso leviter carinatis ventre concaviusculis haud sulcatis; semine scutelliformi incurvo. — Tongatabu, Friendly Islands.

CHASALIA PYRIFORMIS (*Gray, l. c.*); glaberrima; stipulis vaginantibus brevibus; foliis oblongis basi acutis, venis primariis utrinque 7–9; cyma pauciflora sessili; fructu oblongo-pyriformi calycis limbo cupulato vix 4-dentato coronato; pyrenis 2 ventre planis dorso leviter tuberculatis haud carinatis; semine scutelliformi planiusculo. — Samoan or Navigators' Islands.

The following new species of *Psychotria* are all Polynesian, except the last.

PSYCHOTRIA BRACKENRIDGII (*Gray, l. c.*): stipulis caducis; foliis oblongo-lanceolatis utrinque acutis vel acuminatis basi in petiolum longiusculum angustatis fere glabris chartaceis; pedunculis 1–5 terminalibus elongatis cymam trichotomam multifloram gerentibus cum radiis pedicellisque ferrugineo-puberis; fructibus ovalibus 8-costatis truncatis calycis limbo parvo cupuliformi coronatis puberulis; pyrenis tenuiter cartilagineis intus planis dorso convexo carinato-tricostatis. — Feejee Islands. (In fruit.)

PSYCHOTRIA CLOSTEROCARPA (*Gray, l. c.*): glabra; foliis oblongo-lanceolatis magnis basi in petiolum longum angustatis, venis primariis conspicuis utrinque 15–19; cymis terminalibus pedunculatis; fructibus pedicellatis fusiformibus limbo calycis cupulato truncato collo sublatiore coronatis; pyrenis lineari-oblongis apice bidentatis intus planis dorso obtuse tricostatis suberoso-crustaceis. — Samoan or Navigators' Islands. — Fruits about 7 lines long: pyrenæ 2 lines wide.

PSYCHOTRIA FORSTERIANA (*Gray, l. c.*): glabra; stipulis tenuiter scariosis caducis; foliis membranaceis oblongo-lanceolatis nunc obovato-oblongis utrinque acuminatis modice petiolatis, venis primariis 9–11-jugis; cyma multiflora terminati composita tripartita vel tripla, pedunculis radiisve petiolum æquantibus; floribus confertis pedicellatis parvis; calycis limbo expanso integerrimo ovario æquilongo; corolla brevi usque ad medium 5-fida fauce villosissima; fructibus obovatis retusis, junioribus fere obcordatis; pyrenis dorso obtuse costatis subrugosis intus concaviusculis. P. Asiatica, *Forst. Prodr. p.* 16? — Var. VITIENSIS: foliis longius petiolatis nunc undulatis; fructu vix retuso. — Tahiti; Samoan or Navigators' Islands: and the variety from the Feejee Islands.

Psychotria turbinata (*Gray, l. c.*): fere glabra; stipulis caducis; foliis obovato-oblongis nunc oblongo-lanceolatis basi in petiolum longiusculum attenuatis submembranaceis, venis primariis 9 – 10-jugis; cyma terminali multiflora petiolos vix superante; fructibus turbinatis vertice planis; pyrenis 2 vel 3 ventre inferne planis superne profunde exsculptis dorsoque tuberculato-incrassatis.—Feejee Islands. (In fruit: flowers not seen.)

Psychotria insularum (*Gray, l. c.*): glabra; stipulis caducis; foliis oblongis utrinque acutis vel acuminatis longiuscule petiolatis chartaceo-membranaceis, venis primariis 7 – 10-jugis; cyma terminali sessili composita, radiis 3 – 5 trichotomis divisionibusque divaricatis gracilibus apice 3 – 5-floris; floribus graciliter pedicellatis; calycis limbo crateriformi ovario æquilongo, dentibus denticulisve 5 acutissimis; corolla fauce villosissima; fructibus ovoideis breviter coronatis, pyrenis intus planis dorso tricostatis et molliter rugoso-muriculatis. — Samoan and Friendly Islands.

Psychotria tephrosantha (*Gray, l. c.*): stipulis caducis; foliis ovalibus utrinque abrupte acutis vel acuminatis petiolatis ramisque glabris; cyma terminali pedunculata effusa decomposita, pedicellis gracilibus flore brevioribus; calycis limbo subintegerrimo cupulato ovario turbinato breviore; corolla infundibuliformi extus pruinoso-canescente. — Feejee Islands.

Psychotria parvula (*Gray, l. c.*): facie *P. serpentis,* glaberrima; ramis gracilibus foliosis; stipulis caducis; foliis obovatis obtusis in petiolum angustatis (pollicaribus) chartaceis, venis utrinque 5 – 6 inconspicuis; cymis terminalibus laxifloris; calycis limbo parvo acutiuscule 5-dentato; fructibus globosis; pyrenis hemisphæricis dorso 3 – 2-costatis, costis obtusissimis. — Feejee Islands. (Corolla, &c. not seen.)

Psychotria gracilis (*Gray, l. c.*) glaberrima; ramis gracillimis; stipulis quadri-subulatis deciduis; foliis lanceolatis membranaceis attenuato-acuminatis basi in petiolum angustatis; cyma parva terminali pluriflora breviter pedunculata; calycis limbo expanso crateriformi ovario subæquilongo 5-dentato; corolla brevi 5-fida intus glabra; filamentis gracilibus antheris longioribus. — Feejee Islands.

Psychotria calycosa (*Gray, l. c.*): glabra; stipulis caducis; foliis anguste oblongis seu oblongo-lanceolatis subacuminatis basi in petiolum brevem attenuatis; cyma terminali foliis breviore pedunculata confertiflora; floribus pedicellatis; calycis limbo amplissimo foliaceo e basi infundibuliformi expanso 5-lobo; corolla tubuloso-infundibuliformi breviter 5-fido, lobis apice saccatis extus hirtellis intus barbatis. — Feejee Islands. (Fruit unknown.)

Psychotria macrocalyx (*Gray, l. c.*): glabra; ramis gracilibus foliosissimis; stipulis ovatis mucronatis caducis; foliis lanceolatis seu oblongo-lanceolatis longe acuminatis chartaceis basi in petiolum attenuatis; pedunculis 1 – 3 terminalibus 1 – 5-floris pedicellisque filiformibus; calycis limbo tubuloso angusto breviter 5-dentato persistente drupa ovoidea subæquilongo; pyrenis compressis intus planis dorso 1 – 3-carinatis. — Feejee Islands and Tongatabu.

Psychotria filipes (*Gray, l. c.*): glabra; stipulis caducis; foliis lanceolato- seu obovato-oblongis acuminatis basi paullo angustata sæpius subcordatis longe petiolatis; pedunculis terminalibus 2 – 5 filiformibus folia subæquantibus cymam effusam plurifloram gerentibus, radiis 3 – 4 pedicellisque gracilibus; calycis limbo crateriformi 4-dentato ovario breviore; corolla brevi 4-fida fauce fere nuda, fructu immaturo ovato. — Feejee Islands.

Psychotria apodantha (*Gray, l. c.*): stipulis longe setaceo-acuminatis caducis; foliis lanceolatis sensim acuminatis basi acutis obtusisve membranaceis glabris; petiolo primum ferrugineo-puberulo; fructibus paucis terminalibus subsessilibus ovali-oblongis calycis limbo cupuliformi leviter 5-dentato coronato; pyrenis seminibusque intus planis dorso 1 – 3-costatis. — Samoan or Navigators' Islands.

Psychotria hypargyræa (*Gray, l. c.*): glabra; stipulis bifidis caducis; foliis obovato-oblongis seu oblongo-lanceolatis acuminatis basi in petiolum brevem attenuatis chartaceis supra viridibus subtus argento-pallidis; pedunculis 1 – 3 terminalibus apice 3 – 5-floris; floribus brevissime pedicellatis; calycis limbo parvo 5-dentato; corolla infundibuliformi breviter 5-fida intus glabra; filamentis brevissimis; fructibus globosis (in siccis acute costatis) calvis; pyrenis cartilagineis tenuibus ventre planis leviter obcordatis margine acutissimis dorso medio 1 – 3-cristato-alatis; semine triptero. — Feejee Islands.

Psychotria (Piptilema*) cordata (*Gray, l. c.*): glabra; stipulis ovatis? caducis; foliis oblongo- seu lanceolato-ovatis promisse acuminatis basi cordatis longe petiolatis; capitulo arcte sessili plurifloro

* PIPTILEMA, sub-gen. *Psychotriæ, Cephaelidi* proxima. Stipulæ squamaceæ, caducissimæ. Flores sessiles, capitellati, ebracteolati; capitulo terminali primum bracteis squamaceis caducis involucrato. Pyrenæ compresso-planæ, costa dorso in cristam seu alam producta, marginibus inferne subalato-dilatatis. Semen quasi tripterum.

bracteis squamaceis obovato-rotundis circiter 6 caducis involucrato; calycis limbo brevi truncato; corolla tubulosa 5–7-mera; fructibus elongato-pyramidatis, pyrenis dorso alato-cristatis marginibus infra medium angulato-productis. — Feejee Islands.

Psychotria (Piptilema) Pickeringii (*Gray, l. c.*): glabra; stipulis caducis; folliis oblongo-lanceolatis seu obovato-oblongis promisse acuminatis basi angustata subacutis obtusisve; capitulo arcte sessili plurifloro bracteis squamaceis caducis involucrato; calycis limbo brevissimo truncato; corolla tubulosa 4–6-mera; fructibus obovatis obtusis basi quadrangulatis, pyrenis dorso et inferne marginibus cristatis. — Feejee Islands.

Psychotria (Piptilema) platycocca (*Gray, l. c.*): glaberrima; stipulis caducis; foliis oblongis utrinque acutis; pedunculis terminalibus demum lateralibus petiolum adæquantibus glomerulos 1–3 paucifloros bracteis caducis primum involucratos gerentibus; fructibus ovato-tetraquetris, pyrenis dorso et marginibus præsertim inferne acute cristatis. — Feejee Islands.

Psychotria apocynifolia (*Gray, l. c.*): glaberrima; foliis oblongis seu lanceolato-oblongis utrinque acutis vel acuminatis breviter petiolatis membranaceis concoloribus, venis primariis tenuibus angulo recto patentibus prominulis; stipulis brevissimis triangulatis, summis integris, cæteris bipartitis; cyma terminali pedunculata laxiflora foliis breviore; bracteis minimis subulatis; calyce obtuse 5-dentato; corolla infundibuliformi extus scabriuscula intus fauce tantum pilosa; stylo hirtello. — Brazil, near Rio Janeiro.

CALYCOSIA, Nov. Gen.

Calyx tubo angusto; limbo valde ampliato infundibuliformi membranaceo 5-fido, lobis sæpe inæqualibus ciliato-barbatis. Corolla calycem modice superans, tubulosa, fauce infundibuliformi; lobis 5 patentibus apice corniculato-cucullatis æstivatione valvatis. Stamina 5, fauci corollæ inserta, subinclusa: filamenta brevissima: antheræ oblongo-lineares basi bilobæ. Stylus filiformis, basi disco epigyno elevato arcte cinctus: stigmata 2 vel 3, linearia seu filiformia. Ovarium 2–3-loculare. Ovula in loculis solitaria, e basi erecta, anatropa. Drupa apice nuda, dipyrena, raro tripyrena; pyrenis cartilagineis facie planis. Semen cavitati conforme. Embryo in basi albuminis æquabilis cornei parvus; cotyledonibus late ovalibus planis radicula conica brevioribus et latioribus. — Frutices crassiramei, macrophylli; stipulis intrafoliaceis subvaginatis; floribus capitato-congestis, capitulis bracteis latissimis membranaceis inciso-lobatis involucratis ad apicem caulis cymoso-glomeratis.

Calycosia petiolata (*Gray, l. c.*): foliis obovatis seu obovato-lanceolatis in petiolum attenuatis; calyce breviter 5-lobo, lobis oblongis; pyrenis dorso haud costatis. — Feejee Islands.

Calycosia sessilis (*Gray, l. c.*): foliis spathulato-lanceolatis basi sensim angustatis sessilibus; floribus arcte capitato-congestis; calyce ultra medium 5-fido, lobis linearibus; pyrenis dorso tricarinatis. — Savai, one of the Samoan Islands.

The genus is well distinguished from *Psychotria* or *Cephaelis* by the remarkably large, funnel-form, and deciduous limb of the calyx.

6. *Coprosma.*

Of this peculiarly South Sea genus we have six new species from the Northern hemisphere, — namely, from the Sandwich Islands. All but one of them, however, have lain long in herbaria. The two most remarkable species, *C. rhynchocarpa* and *C. ernodeoides*, were gathered, one of them by Nelson, in Cook's last voyage, the other, as well as *C. Menziesii*, by Menzies, in Vancouver's voyage. We have also a species from Tahiti, and another from the Feejee Islands.

Coprosma rhynchocarpa (*Gray in Expl. Exped. ined.*): fruticosa, fere glabra; stipulis triangulari-acuminatis basi connatis; foliis chartaceis oblongis seu lanceolato-oblongis acutis basi in petiolum gracilem attenuatis; pedunculis paucifloris pedicellisve brevissimis; fl. masc. calyce subintegro tubo corollæ 6–7-fidæ breviore, fl. fœm. 5–6-mero, calycis tubo ultra ovarium globosum longissime producto (limbo cupulari breviter 5–6-dentato) super drupam rostri instar persistente. — Hawaii, Sandwich Islands: gathered also by Nelson, Macrae, and Gaudichaud. — Most remarkable for the beak of the fruit, from $1\frac{1}{2}$ to 3 lines long, and forming as it were a stipe to the small, abruptly dilated limb of the calyx persistent on its summit.

Coprosma longifolia (*Gray, l. c.*): glaberrima, fruticosa; stipulis in vaginam oblongam coalitis e basi circumscissa caducis; foliis subcoriaceis nitidulis lanceolatis utrinque acutis sublonge petiolatis; pedunculis fructiferis petiolo brevioribus capitato-plurifloris; drupa ovoidea calycis limbo brevi 5–7-dentato apiculato. — Oahu, Sandwich Islands: also gathered by Gaudichaud.

Coprosma foliosa (*Gray, l. c.*): fruticosa, glabra; stipulis triangulari-acuminatis basi subconnatis; foliis chartaceis lanceolatis seu oblongo-lanceolatis utrinque acutis vel acuminatis; pedunculis petiolo gracili brevioribus paucifloris; floribus 6 – 7-meris; drupa obovato-globosa apice nuda. Euarthronia foliosa, *Nutt. in Herb. Hook.* — Oahu, Sandwich Islands: where it was also gathered by Gaudichaud, Nuttall, and Seemann.

Coprosma pubens (*Gray, l. c.*): fruticosa; stipulis late deltoideis connatis strigoso-sericeis; foliis chartaceis obovato-oblongis oblongisve basi in petiolum attenuatis supra glabratis subtus reticulato-venosis ramulisque pubescentibus; pedunculis petiolo brevioribus vel subnullis; floribus confertis, masculis 6 – 7-meris, calyce irregulari, corolla breviter infundibuliformi. — Var. *α.* drupis secus ramos subsessilibus basi bibracteolatis ovoideis rostello brevi apiculatis. Var. *β.* Kauensis: drupis obovatis obtusissimis plurimis sessilibus in pedunculo communi. — Sandwich Islands.

Coprosma Menziesii (*Gray, l. c.*): fruticosa; ramis pubentibus; stipulis brevibus connatis sericeo- vel strigoso-pubescentibus; foliis obovatis seu ovalibus raro oblongis reticulatis glabris; pedunculis paucifloris brevibus sæpe aggregatis vel compositis; floribus 5 – 11-meris; calyce cupulato breviter dentato; drupa subglobosa calycis limbo brevi coronata. — Var. *α.* foliis chartaceis demum coriaceis ovalibus seu ellipticis acutis vel obtusis basi in petiolum longiusculum vel brevem contractis. Var. *β.* foliis chartaceis longiuscule petiolatis; pedunculis fœmineis geminis ternisve 1 – 3-floris gracilibus. Var. *γ.* foliis minoribus spathulatis obovatisve crassis in ramulos confertissimis breviter petiolatis; drupis fere sessilibus. — Hawaii, Sandwich Islands. Collected by Menzies, Macrae, Gaudichaud, and Douglas.

Coprosma ernodeoides (*Gray, l. c.*): fruticosa, procumbens, glabra (nisi ramis junioribus); stipulis brevissimis connatis; foliis confertissimis parvis sublinearibus crassis aveniis nitidis sempervirentibus margine parce hispidulis; floribus fœmineis sessilibus ramulos terminantibus 4-meris; corolla tubulosa; drupa globosa. — Hawaii, Sandwich Islands. Collected by Menzies, &c.

Coprosma Taitensis (*Gray, l. c.*): *C. robustæ* affinis, glaberrima; stipulis triangulatis acutis subconnatis persistentibus; foliis subcoriaceis oblongis obtusis basi in petiolum angustatis; pedunculis brevissimis vel breviusculis 2 – 5-floris; drupa obovato-globosa apice nuda. — Tahiti, Society Islands. (In fruit only.)

Coprosma persicæfolia (*Gray, l. c.*): fruticosa, glabra; stipulis connatis late triangulatis cuspidatis; foliis membranaceis lanceolatis sensim acuminatis, petioli brevi; pedunculis brevissimis paucifloris; calycis limbo vix dentato; corolla profunde quadrifida; drupa oblonga. — Feejee Islands.

The Corresponding Secretary, in behalf of the author, presented the following paper: —

Salices Boreali-Americanæ: a Synopsis of North American Willows. By N. J. Andersson, Professor of Botany in the University of Stockholm, Sweden.

In attempting an enumeration of the Willows of North America, every author must feel himself rather at a loss. Any acquaintance, even the most superficial, with the different species of that genus, is sufficient to show that a proper treatment of the subject requires, not only access to the richest collections, but also an opportunity of seeing almost every shrub for many years. Distributed over a great part of the surface of the globe, inhabiting a great variety of localities, the species of this genus are exposed to the most heterogeneous influences from all kinds of soil and all variations of climate, — thus presenting a greater multiplicity of forms than most plants now known. The literature of the subject also proves how very difficult it has been, and perhaps ever will be, to establish certain determinations. While some authors believe that there are only a few species, others (as Schleicher, Tausch, Host, &c.) seem to think "species tot numeramus, quot creata sunt individua." If, then, a botanist most favorably situated for the purpose finds it no easy matter rightly to understand the Willows of his own limited native country, how embarrassed must not a stranger be, who tries to form an exact idea of this intricate genus in a distant and extensive part of a new world, which he has seen only in one spot (California), and for a few weeks? But, as it may perhaps always be impossible for one person fully to examine, in a living state, and in their native regions, the Willows of Lapland, Switzerland, the Pyrenees, Siberia, Himalaya, and North America (not to speak of the tropical regions), and as it nevertheless is of advantage to science to have a synopsis of all the known species, constructed upon uniform principles, a botanist may hope to be favorably judged when he undertakes to publish his views of these plants, after having studied them in several of their natural districts, and in the largest collections.

For two years I occupied myself with the Willows in various regions of Lapland. I afterwards collected them in the *Riesengebirge* (Silesia), in Switzerland, and in many parts of the Continent, and in England. I have consulted the herbaria, as well as the botanical gardens, of Paris, Berlin, and Vienna; also the herbaria of M. De Candolle and of Sir W. Hooker, the latter the largest now existing, and especially rich on plants from North America. For many years I have wished to publish some general remarks upon this genus; and M. De Candolle has lately honored me with a request to elaborate it for his celebrated *Prodromus*.

But in arranging for such a work my annotations upon the Northern species, I could but know how imperfect is our knowledge of the North American forms. As the Willows especially belong to cold regions, why should they not be as numerous in America as in Europe or Asia? As they are with us so extremely subject to variations and to hybridizations (a fact now generally acknowledged), must it not be the same in the New World? To answer these and similar questions, our materials in Europe are not sufficient, and all determinations founded upon them alone must be imperfect, and liable to frequent mistakes. In this diœcious genus it is very important to be sure that the specimens, both of leaves and flowers, belong to the same species, and that the foliage, flowers, and fruit should be taken from the very same shrub. But in herbaria the specimens — gathered by travellers who generally care little for Willows — often are so imperfect, confused, and miserable, that they only serve to make the study more difficult and uncertain.

Looking into the American Floras, published by various authors since the time of Michaux, we find that the indigenous Salices of America (with the exception of a few of the most arctic) all have names totally differing from the European species. Now this was hardly to be expected, when the well-known fact is considered that the vegetation of a large part of the Northern regions is, I dare not say quite identical, but very uniform or homogeneous, all round the world. Hence, although the indigenous Willows in America generally are considered different from those in the Old World, we should look for a greater resemblance than has yet been recognized, not only in the higher arctic regions (as partially shown in Hooker's Flora Boreali-Americana), but also in the more southern parts.

And, in fact, my inquiries have persuaded me that the similarity or analogy in this respect is greater than is generally supposed. With my experience of the European Willows, which frequently vary from one extremity of size, form, and color to another, according to the area of the species (e. g. *S. nigricans*), and which in different countries not seldom have the most different aspects (e. g. *S. Lapponum* and *S. glauca* in Lapland and Switzerland), I could not be surprised to find many American Willows equally varying from ours, although certainly belonging to European types, or at least so analogous to their European relatives that they might be considered as subspecies of them, till we discover the intermediate forms which are the connecting links of that unbroken series which we may consider as constituting a true natural genus. This idea, is it anything more than my individual opinion? It must be proved by others; it must be ascertained by diligent, unprejudiced, and accurate researches upon the living species in America, and especially by botanists who have acquired a profound acquaintance with the European species, as older in the history of the science.

My esteemed correspondent, Professor Asa Gray, who has kindly promised to assist me in procuring materials for a more complete treatise upon this very difficult genus, has encouraged me to send him an enumeration of the American species already known to me, which may be brought to the notice of botanists of the United States generally, in the hope that they may be induced to make renewed and critical observations upon the species indigenous around them, and also to favor me with contributions of specimens, which are so greatly needed to perfect my contemplated revision of the entire genus for De Candolle's *Prodromus*.

I have tried to lay before the reader some of the reasons why I must consider several American species as very much allied to, or perhaps identical with, ours in the Old World. But neither time at present, nor the space at my command, has permitted me to treat the matter at the length requisite to prove the correctness of my opinion. I have also been obliged to restrict this communication to short diagnoses only for the new species here proposed, and to a few synonymes from the principal American Floras. Should this essay fulfil its purpose of directing the attention of the botanists of the United States to this difficult genus, and bring forth the materials and the observations needed to dispel the many remaining doubts, the author may perhaps hereafter find an opportunity of publishing, in the New World, a complete monograph of the North American Salices, and thus "*redit ad Dominum quod fuit ante suum.*"

A. AMERINA, *Fries.*

I. Australes. — Hæc tribus, staminibus numerosis, filamentis subfasciculatis basi sæpius hirsutis, antheris minutis rotundatis, squamis rotundatis tomentosis, capsulis plus minus longe pedicellatis et ovato-globosis, nectario subcirculari insignis, *Amygdalinis* omnino analoga, regionibus meridionalibus et tropicis fere priva videtur. Huc pertinent species omnes Africæ et Americæ Australis indigenæ, Indiæ Orientalis et Persiæ pleræque (*S. tetrasperma* et affines); nonnullæ (*S. Humboldtiana, S. Bonplandiana, S. Hartwegi*, etc.), Americam Centralem transgredientes, etiam Mexico australem incolunt.

1. S. nigra, *Marsh.; Hook. Fl. Bor.-Am.* 2, *p.* 198; *J. Carey in Gray, Man. ed.* 2, *p.* 417. S. ambigua, *Pursh.* S. Houstoniana, *Pursh.* S. Caroliniana, *Michx.* S. falcata, *Pursh* (S. Purshiana, *Spring.* S. ligustrina, *Michx. f.*).

2. S. longipes, *Shuttlew. ined.:* pentandra; amentis lateralibus pedunculatis laxis; pedunculo foliato; capsulis ovato-globosis glabris, pedicello nectarium sexies superante; stylo subnullo; stigmatibus brevibus indivisis; foliis lanceolato-oblongis demum glabris subtus glaucis reticulato-venulosis exstipulatis.

Var. pubescens (S. gongylocarpa, *Shuttlew.*): capsulis subcrassioribus fere longius pedicellatis; foliis utrinque hirsutis.*

Hab. Prope St. Mark's, Florida, *Rugel.*

Utraque forma non parum cum priori congruit, multis autem notis (foliis exstipulatis, etc.) ab ea differt.

3. S. amygdaloides, n. sp.: triandra; amentis lateralibus pedunculatis rigidiusculis; pedunculo foliato; capsulis ovato-conicis glabris, pedicello nectarium sexies superante; stylo subnullo; stigmatibus bre-

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* This is the S. subvillosa, *Ell. in Herb. Schweinitz, ex Nutt. N. Am. Sylva*, 1, *p.* 79, — a work to which Prof. Andersson had not access, — also mentioned in *Ell. Bot. S. Car. & Georg.* 2, *p.* 671, under *S. nigra.* A. G.

vissimis partitis; foliis late lanceolatis utrinque glaberrimis subtus pallidioribus, margine glanduloso-serratis exstipulatis.

HAB. Missouri, Fort Pierre, *Neuwied, in Herb. Vindob.*

Hæc species, præ cæteris affinibus, *S. amygdalinam* nostram latifoliam refert. Habitu quasi hybrida ex *S. lucida* et *S. nigra*, huic fructibus, illi foliis omnino similis.

II. FRAGILES, *Fries.*

4. S. (PENTANDRA) LUCIDA. — S. lucida, *Muhl.; Hook. l. c. p.* 198; *J. Carey in Gray, l. c. p.* 417.

Var. LATIFOLIA: foliis apice plerumque longe cuspidatis.

Var. OVATIFOLIA: foliis non vel abrupte cuspidatis. — Forma DENSIFLORA: capsulis condensatis majusculis, squamis subpersistentibus (L. Winipeg, *Herb. Benth.*).

Var. ANGUSTIFOLIA. — Forma LASIANDRA (S. lasiaudra, *Benth. Pl. Hartw. p.* 335): squamis amentorum glandulosis; filamentis basi subpilosis (California, *Hartweg, J. M. Bigelow*). — Forma PILOSA: foliis subtus passim rufo-pilosis. (Columbia River; L. Winipeg; Fort Franklin.)

Primo obtutu hæc species a nostra *S. pentandra* non parum differt; comparatis autem formis e variis partibus Americæ et Europæ, affinitas ne dicam identitas negari non potest. Etiam apud nos folia adsunt longe cuspidata, ut et in America folia obtusiuscula, non lucida.*

5. S. FENDLERIANA, n. sp.: tri–pentandra; amentis pedunculatis foliatis erectis; squamis amenti masculi magnis margine glandulosis; capsulis ovatis glaberrimis, pedicello nectarium sexies superante; stylo evidenti; stigmatibus minimis integris; foliis ovatis acutis utrinque glaberrimis creberrime glanduloso-serrulatis; stipulis sat magnis glanduloso-serratis.

HAB. New Mexico, *Fendler* (Pl. N. Mex. no. 816); Rocky Mountains, *Geyer,* no. 287.

Habitu toto cum *S. lucida* maxime congruit; sed differt, capsulis brevibus longius pedicellatis, necnon foliis crebrius glanduloso-serrulatis, quibus notis etiam a *S. amygdaloide* dignoscitur, cui omnino analoga.†

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* Nuttall, in his N. Am. Sylva, supplementary to that of Michaux, Plate 18, has figured a form of *S. lucida* as *S. pentandra,* var. *caudata,* from the western side of the Rocky Mountains. A. G.

† This appears to be the *S. speciosa* of Nuttall (*Sylva,* 1, *p.* 58, *t.* 17), from Oregon. There is a much older *S. speciosa* of Hooker and Arnott, from Kotzebue's Sound. Vide no. 22. A. G.

6. S. Wrightii, n. sp.: amentis pedunculatis; pedunculo foliis 2 – 3 oblongis obtusiusculis instructo; squamis facillime deciduis; nectario basin pedicelli semicirculatim cingente; capsulis ovato-conicis glaberrimis sat longe pedicellatis, pedicello capsulam dimidiam superante gracili; stigmatibus sessilibus integris; foliis anguste lanceolatis longius acuminatis tenuissime glanduloso-serrulatis utrinque glaberrimis subtus pallidioribus; stipulis caducis; ramis erectis pallide testaceis nitidis.

Hab. New Mexico, *C. Wright*, Coll. 1851 – 2, no. 1877.

A cæteris hujus tribus speciebus differt foliis angustissimis (2 – 3-pollicaribus, vix 4 lin. latis) utrinque glaberrimis, amentis brevioribus et crassis (vix pollicaribus). A *S. alba vitellina*, cui sane proxima, foliis et capsulis longe pedicellatis facillime dignoscitur.

7. S. alba, *L.; J. Carey in Gray, Man. ed.* 2, *p.* 416. Var. S. vitellina, *Smith* (= S. Pamechiana, *Barratt*, sec. *J. Carey in Gray, Man. l. c.;* quam tamen ad *S. fragilem* e speciminibus ducerem). — Var. S. cærulea, *Smith.*

8. S. viridis, *Fries, Novit. p.* 283. S. fragilis, var. proteifolia, *Barratt in Herb. Hook.*

A. *S. alba* differt amentis longis acutis et flexuosis, ramulis subpendulis, foliis latioribus utrinque viridibus et lucidis. A *S. fragili*, ramulis tenacibus pendulis, foliis cuspide recta acutatis, maturis consistentia durioribus, sub prelo non nigrescentibus, amentis erectis.

9. S. fragilis, *L.; Hook. l. c.; J. Carey in Gray, Man. l. c.* — Var. S. decipiens, *Hoffm.:* foliis obtusiusculis; cortice ramulorum pallide testaceo. — Var. S. Russelliana, *Smith:* arbor excelsa; foliis maximis acutissime serratis.

III. Longifoliæ. Amenta in ramulis lateralibus annotinis elongatis valde foliatis terminalia; squamæ spathulato-ligulatæ, apice sæpissime glandulosa-denticulatæ. (Folia primaria pinnato-incisa !)

10. S. longifolia, *Muhl.; Hook. Fl. Bor.-Am.* 2, *p.* 149; *Gray, Man. p.* 147. S. rubra, *Richards* (*sec. Hook.*).

Jam cognitum est nullam fere aliam Salicis speciem (*S. cordata* et *S. vagante* forte exceptis) in America crescentem mire variationibus ludere. Statura nunc bipedalis, nunc 4 – 5-orgyalis (qualem in California ipse vidi), nunc stricte erecta arboris instar, nunc humifusa vel repens, rami longius viminei aut breves subtorulosi, cortice vario obducti; folia latitudine et longitudine, indumento et serratura eximie varia, ut etiam amenta. His omnibus perspectis species sequentes (*S. sessilifoliam, Hindsianam* et *S. taxifoliam*) tantum ut formas australes et occidentales ejusdem per Americæ regiones latissime dispersæ speciei proponere vellem: quam autem in serie contigua a formis maxime latifoliis et vegetis ad minimas, microphyllas et pumilas, membra adhuc desiderantur nonnulla, eas seorsim descripsi donec, quod hic autumavi, omnibus sit expertum. Inter formas autem numerosissimas *Salicis* vere *longifoliæ* hæc precipue notanda: —

Var. ANGUSTISSIMA: amentis laxifloris et eximie remotifloris; capsulis squamas acutiusculas hirsutas primo non excedentibus basi parum gibbis subcylindricis densissime sericeis breve pedicellatis; foliis angustissimis et argute dentatis exsiccatione fusco-nigrescentibus. — Hab. in Texas, *Berlandier*, No. 911, 3019, 2341, 2368); N. Mexico, *C. Wright*, Coll. no. 1875.

11. S. SESSILIFOLIA (*Nutt. in Herb. Hook.**): amentis masculis uncialibus crassiusculis cylindricis acutis densifloris; squamis oblongo-ovalibus filamentis triplo brevioribus et pilis albis staminibus brevioribus dense vestitis; antheris post anthesin fulvescentibus; foliis pollicaribus sessilibus exacte lanceolatis medio semipollicem latis acuminato-cuspidatis utrinque dense griseo-tomentosis (pilis sat longis subadpressis micantibus vestitis) integerrimis. — Hab. Oregon, *Nuttall, Lobb.*

* HINDSIANA, *Benth. Pl. Hartweg, & Herb.*: amentis brevibus (vix semipollicaribus); squamis acutiusculis dense tomentosis; antheris pallide flavis; capsulis breve pedicellatis e basi gibba longe rostratis rugulosis glabriusculis; foliis anguste lanceolatis (medio $2\frac{1}{2}-3$ lin. latis) margine integerrimis utrinque adpresse sericeis. — Hab. California, *Hartweg.*

Ad eandem seriem hæc ultima, regionum subtropicarum incola, etiam pertinet:

S. TAXIFOLIA, *H. B. K. Nov. Gen. & Spec.* 2, *p.* 22 (1817). S. microphylla, *Schlecht. & Cham. in Linnæa*, 6, *p.* 354 (1831): pulcherrima, ut mihi videtur, formis supra memoratis haud dubia in *S. longifoliam* sensim abiens.

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* Published by Nuttall in his *N. Am. Sylv.* 1, *p.* 68, 1842. A. G.

B. HELIX, *Fries.*

12. S. PURPUREA, *L.; Hook. l. c.; J. Carey in Gray, Man. p.* 415.

13. S. VIMINALIS, *L.; Hook. l. c.; Gray, Man. l. c.*

C. VETRIX, *Fries.*

I. TEMPERATÆ (*Subdaphnoideæ*).

14. S. ACUTIFOLIA, *Willd.* — Ramum foliatum tantum vidi.

15. S. (DAPHNOIDES) IRRORATA, n. sp.: amentis sessilibus perulis maximis primo bracteatis valde condensatis, masculis brevibus, fœmineis horizontalibus elongatis densifloris; capsulis sessilibus crasse conicis glaberrimis; stylo producto; stigmatibus integris; foliis lanceolatis utrinque viridibus; ramis densissime glauco-irroratis.

Hab. N. Mexico, *Fendler,* no. 812.

Nostræ *S. daphnoidi* ita est similis, ut nullis notis nisi amentis eximie condensatis et foliis (novellis?) integerrimis utrinque viridibus ab ea distingui possit. Squamæ amenti masc. pilis brevibus aureis vestitæ; squamæ amenti fœm. pilis sat brevibus griseis ciliatæ; unde amenta fœm. non ut in vera *S. daphnoide* longe pilosa conspicuntur.

16. S. ERIOCEPHALA, *Michx. Fl.* 2, *p.* 225; *J. Carey, in Gray, Man. p.* 414.

E Salicibus Americanis hæc mihi fere maxima obscura. Specimina numerosa, inter se eximie diversa, nunc *S. eriocephala* Michx., nunc *S. crassa* Barratt, nunc *S. prinoides* Pursh (Hook. l. c. p. 150), nunc *S. conifera* Willd., nunc immo *S. myricoides,* a me examinata, confusionem tantum adhuc majorem reddiderunt, nec e diagnosibus auctorum quidquam certi eruere potui. Exstant specimina gemmis maximis oblique conicis, stipulis semicordatis et serratis, foliis sat longe petiolatis (petiolo basi dilatato gemmam amplectente) demum rigidis subtus glaucis, margine argute serratis, supra saturate viridibus et lucidis nervis conspicuis percursis, amentis omnino nudis, masculis e gemmis erumpentibus pilis fulvo-aureis densissime villosis, squamis et staminibus pilis chryseis absconditis, amentis fœmineis pilis cinerascentibus obtectis, stylo elongato, etc. — ita omnino cum nostra *S. daphnoide* congruentia, ut formis numerosis quibus ea apud nos mirum in modum luditur perspectis, hanc ut formam parum aberrantem haberem. Obstant autem rami rarissime glaucescentes, folia margine remotius serrata, præcipue autem capsulæ multo angustiores, distincte pedicellatæ et sericeo-pubescentes. Exstant etiam specimina quædam, ad *S. discolorem* non indubie transeuntia, amentis magnis laxis et rarifloris, capsulis sat longe pedicellatis foliis fere ut in *S. grandifolia* nostra, obovato-elongatis margine repandis et sinuato-dentatis. Maxime autem memorabilis videtur quadam *grisea*, foliis utrinque hirtis subtus subferrugineo-pilosis, ramis cinereo-villosis et amentis iis *S. cinereæ* similibus, sed stylo producto distincta. Quibus omnibus sequitur me de hac specie vix quidquam certi cognoscere; quare omnes rogo velint specimina varia diligenter et accurate observare.

17. S. Bigelovii, *Torr. in Herb. Hook.* [*& in Bot. Pacif. R. R. Expl.* 4, *p.* 139]: amentis sessilibus bracteis facillime deciduis paucis suffultis; capsulis ovatis brevibus obtusiusculis glabris, pedicello nectarium bis superante squamam subrotundam pilosam subæquante; stylo elongato; stigmatibus brevibus erectis bipartitis; foliis ovali-obovatis integerrimis subtus adpresse flavido-tomentosis nigrescentibus.

Hab. California, *J. M. Bigelow*, 1854.

Quoad foliorum forma et indumentum (quod tamen fusco-flavescens) et amenta ebracteata densiflora similitudinem quandam cum *S. Coulteri* habet: capsulæ autem iis *S. hastate* similiores. Unicum tantum specimen vidi.

18. S. lasiolepis (*Benth. Pl. Hartweg. & Herb.*): amentis sessilibus nudis adscendentibus; squamis cuneato-subrotundis tomento densissimo et brevi obtectis capsulas fere occultantibus; capsulis acutis glaberrimis, pedicello nectarium bis superante; stylo mediocri; stigmatibus crassis brevibus integris; foliis lanceolatis vel late lingulatis acutis supra glaberrimis subtus ferrugineo-glaucis margine subsinuatis.

Hab. California (near Monterey), *Hartweg*, no. 167.

Pulcherrima species, *Vetrices* et *Capreas* quodammodo ambigua. Arbor dicitur 20 – 25-pedalis: rami crassiusculi, atri, novelli tomentosi. Folia 3 – 4-pollicaria, sæpius semiuncia latiora, supra nitide viridia, subtus glauca, indumento ferrugineo juxta nervos relicto colorata. Amenta mascula fere bipollicaria, erecta, subflexuosa: squamæ atræ, rotundatæ, basi angustatæ, pilis aureo-fulgentibus vestitæ; filamenta squamas duplo superantia; antheræ minutæ, oblongæ, etiam aureæ. Amenta fœminea vix breviora, sed subangustiora; squamæ capsulas lineales flavo-virides supra medium tegentes, densissimæ cano-tomentosæ.

19. S. Coulteri, n. sp.: amentis omnino sessilibus bracteis 2 – 3 suffultis; squamis fulvis pilis albis longissimis dense hirsutis; foliis

oblongis supra obscure viridibus costa alba, subtus vellere lucido argenteo densissime tomentosis; ramis angulatis dense griseo-tomentosis.

Hab. California, *Coulter.*

Hæc species, cujus tantem tria specimina foliis rite evolutis et amentis masculis prædita vidi, non absque dubio affero: cum nulla a me cognita attamen confundenda, ab id præcipue insignis, quod *S. eriocephalam* cum *S. lanata* (mediantibus *S. Hookeriana* et *S. speciosa*) serie naturali aperte connectit.

II. Arcticæ vel Subarcticæ.

20. S. Hookeriana, *Barratt in Hook. Fl. Bor.-Am.* 2, *p.* 145, *t.* 180.

Amentis masculis est *S. daphnoidi* subsimilis, amentis fœmineis *S. hastatæ*, foliis autem *S. lanatæ!*

21. S. lanata, *L.*, var. Americana: capsulis hirsutiusculis.— Forma *α*. S. Barrattiana, *Hook. l. c. p.* 146, *t.* 145: capsulis sericeis; foliis tomentosis magnis, amentis sæpius lateralibus. *β*. S. Richardsoni, *Hook. l. c. p.* 147, *t.* 182: capsulis et foliis glabriusculis; foliis minoribus; amentis subterminalibus.

In Lapponia *S. lanata* sub multis formis frequens occurrit; sunt quædam his Americanis tam similes ut nec habitu nec notis ullis distingui possint. Exstant apud nos formæ numerosæ ad *S. glaucam*, sed optime ad *S. hastatam* accedentes, quarum folia glabrescunt, et amenta lateralia fiunt. Americana potius ad *S. Lapponum* vergit; hæc etiam multo humilior crescere videtur (præsertim *S. Richardsoni*). E Siberia partibus variis eadem variationes etiam adsunt.

22. S. speciosa, *Hook. & Arn. Bot. Voy. Beech. p.* 130; *Hook. l. c. p.* 145; *Seemann, Bot. Voy. Herald, p.* 40, *t.* 10.

Quanquam Salici cuidam, *S. amygdalinæ* affini, hoc nomen jam 1818 imposuit Host, id tamen huic speciei Americanæ conservandum censeo, ut pote Salici omnium in regionibus borealibus crescentium facile speciosissimæ aptissimum.

23. S. Lapponum, *L.; Hook. l. c. p.* 151? S. Stuartiana, *Smith, Hook. l. c.*

Fateri debeo me nulla specimina Americana hujus speciei certe vidisse. Non sine hæsitatione permulto huc refero Salicem eam "pulchram," de qua Chamisso (Linnæa, 6, p. 543) in America arctica occidentali pluries a se lecta, mentionem fecit. Amenta sessilia: capsulæ non pedicellatæ, sed folia fere ut in *S. phylicifolia* utrinque acutata, viridia, subtus pallidiora, glaberrima: stipulæ persistentes lineares. Unicum tantum specimen ex herb. Berolinensi vidi. Notandum ut *Salicem Lapponum*, alpium summarum incolam, etiam folia nonnunquam habere glabrescentia.

24. S. CÁNDIDA, *Willd.; Hook. l. c. p.* 148; *J. Carey in Gray, l. c.*

D. CAPREA, *Fries.*

I. CINERASCENTES, *Fries.* Stigmata sessilia! Amenta præcocia, vix pedunculata.

25. S. (CAPREA) CAPREOIDES, n. sp.: amentis sessilibus bracteis paucis et minutis primo suffultis densifloris; capsulis pedicellum quinquies superantibus sericeis; foliis obovatis vel oblongis basi angustatis subtus glaucescentibus pilis rufescentibus villosis denique (nervis exceptis) glabris.

Hab. California (*Coulter*) et Oregon, *Herb. Hook.*

S. caprea vera Europæa, quantum scio, in America nullibi reperta, hæc forma eam ibi optime representat. Quod ad fructificationis partes vix ulla exstat differentia essentialis. Amenta mascula tamen angustiora, sed fœminea crassiora, utraque quam in nostra breviora; squamæ fere majores, atratæ, obovato-spathulatæ; capsulæ e basi gibbo fere cylindricæ, $2\frac{1}{2}$ lin. longæ; stigmata sessilia erecta. Folia novella utrinque rufo-hirsuta, subtus etiam vellere albo plus minus denso obtecta, denique denudata, integerrima, dura. Gemmæ, ut in *S. caprea* vera, subglobosæ glabræ; rami sæpius obscuri et glabri. — Proxima huic sine dubio est *S. brachystachys;* quæ tamen differt amentis adhuc brevioribus, foliis densissime albo-velutinis.

26. S. CINEREA, *L.?* — In herbaria Hookeriano specimina adsunt duo, quantum videre possum ad hanc speciem referenda, quibus annexus erat ramus foliis parvis glabris, omnino iis *S. rostratæ* simillimis, obtectus. Vereor ne confusione quadam commixta sint?

Hab. "Thickets along rivulets, Columbia River valley, near Fort Colville; 15 – 20 feet high, shrubby, *C. A. Geyer.*"* Num *S. caprea* vel *S. cinerea* hic crescit?

27. S. (AURITA) BRACHYSTACHYS, *Benth. Pl. Hartweg, & Herb.:*

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* These specimens are described, under the name of *S. grisea?* in Hook. Kew Jour. Bot. 7, p. 372. A. G.

amentis sessilibus nudis brevibus ovatis; squamis pilis longissimis sericeis dense vestitis; capsulis villosis acutatis, pedicello nectarium 4–5-ies superante; stylo nullo; stigmatibus longis integris divaricatis; foliis obovatis subtus densissime velutino-tomentosis demum glabrescentibus rufescenti-nervosis.

Hab. California (woods near Monterey), *Hartweg*, no. 1957.

Frutex dicitur 4-orgyalis, sat similis videtur prioribus; sed differt, amentis semiuncialibus, squamis mediocribus rufescentibus pilis duplo vel triplo longioribus densissime sericeis, pedicello breviore, foliis 1½ unc. longis supra medium unciam latis subtus molliter velutinis. E nostris speciebus in Europa indigenis *S. aurita* L. sine ullo dubio huic tam similis ut hanc facile subspeciem ejus haberem.

Sub nomine *S. Scoulerianæ* Barratt, *Hook. l. c. p.* 145 in herbario Hookeri vidi specimina duo florentia ad *S. brachystachym* absque ullo dubio pertinentia, et specimen foliatum *S. Sitchensis* Sanson. Hoc nomen itaque e Salicum turba excludendum.

28. S. VAGANS, Anders. — Qui *S. depressam* Scandinaviæ, *S. Starkeanam* Rossiæ et Borussiæ, et *S. rostratam* Americæ Borealis eamque formas attente, nulla certa opinione præoccupatus, comparare studet, non potest quin eas omnes ad unam eandemque Salicum speciem pertinere credat. Hoc mihi saltem, specimina fere innumera, e variis terris inspicienti, omnino persuasum habeo. Nominibus jam allatis formas varias tantum spectantibus, *vagantis* nomine speciem notare volui, quæ per terras plurimas septentrionalis late vagatur, quæ insuper notis admodum vaga est. Variat statura, de qua Linnæus in Flora Lapponica, no. 361 "arbor parva," sed in Flora Suecica "arbuscula ad terram depressa": variant folia nunc glabra nunc villosa, nunc magna nunc parva, nunc lanceolata nunc ovata vel obovata: rarissima autem variant amenta laxiflora, capsulis angustis (glabris seu hirtis) subcylindricis longissime pedicellatis et stigmatibus coronatis sparsim ornata. His præmissis hujus speciei sequente modo proponendas censeo: —

1. *Cinerascens:* foliis velutinis.

Var. α. LINNÆANA (cfr. *Fries, Nov. Mant.* 1, *p.* 59): foliis plerumque obovatis supra demum glabratis. *Linn. Fl. Lapp. no.* 361 (sec. *Fries*). S. livida β. cinerascens, *Wahl. Fl. Lapp. no.* 273. S. depressa, α. cinerascens, *Fries, l. c. p.* 57. S. depressa, velutina, *Koch.* S. sphacelata, *Smith.*, nomen ambiguum!)

Forma ELATA : orgyalis, Wahl. l. c.

" DEPRESSA : foliis crassioribus utrinque tomentosis. S. depressa, *L. Fl. Suec.* S. livida *β.* in alpibus, *Wahl.; Fries, l. c.*

Hab. ex alpibus (forma depressa) juxta flumina (forma elata) in regiones sylvaticas Lapponiæ descendens.

Var. *β.* OCCIDENTALIS : arbor 4–15-pedalis; foliis plerumque lanceolatis demum rigidis et læviusculis sinuato-crenatis (fere ut in *S. caprea*). S. rostrata, *Richards.; Hook. l. c.; Gray, l. c.*

Hab. per Amer. Sept. omnem et in Siberiæ partibus orientalibus.

2. *Glabrescens:* foliis glaberrimis lucidis subtus pallidioribus.

Var. *α.* INTERMEDIA : frutex parvus et humilis; foliis sæpius late obovatis subcoriaceis; amentis masculis tenuibus; staminibus flavis; pedicello capsularum nectarium sexies superante.

Forma LIVIDA : foliis subtus lucido-glaucis; capsulis glabris vel sericeis, S. livida, *α. Wahl.* S. depressa, *β. Fries.*

" BICOLOR : foliis subtus glaucis haud lividis. S. depressa, *γ. Fries, l. c.*

Hab. in regionibus mediis (*livida*) et meridionalibus (*bicolor*) Sueciæ.

Var. *β.* ORIENTALIS : frutex altior; foliis majoribus utrumque glaberrimis margine sinuatis; amentis masculis crassioribus; staminibus fulvis; capsularum pedicello nectarium sæpe novies superante. S. Starkeana, *Willd.*

Hab. in Silesia et prope Kœnigsberg Borussiæ, necnon per Rossiam medium et septentrionalem.

Et J. Carey in Gray, Man. l. c., et Hooker hanc speciem in America valde esse variabilem affirmant. Formas majores foliis fere ut in *S. caprea* longis (sed multo angustioribus), obovatis et acutis, margine sinuatis, textura duris, subtus tomentosis, supra obscure viridibus in formas minores foliis lanceolatis aut obovato-oblongis, junioribus rufescenti-pellucidis, nervis subtus elevatis costatis abire videmus, omnino ut s. d. *S. depressa* in Scandinavia ubi forma *cinerascens* altitudinem orgyalem sed forma *livida* vix bipedalem attingit. Has formas *lividas* et *bicolores* ex America non reperimus. Amenta mascula *S. rostratæ* omnino ut in *S. Starkeana*, i. e. quam in vera *S. depressa* paullo longiora et crassiora, pilis fulvis squamarum magis hirsuta; amenta fœminea vulgo quam in nostra longiora, sed capsulæ omnino æquales. Etiam in America margines sylvarum et pratorum inhabitare dicitur.

29. S. Geyeriana, n. sp.: amentis breve pedunculatis bracteis paucis suffultis brevibus subramifloris; capsulis ex ovata et crassa basi conicis tenuiter sericeis, pedicello nectarium sexies superante; stigmatibus sessilibus cruciformibus; foliis lineari-lanceolatis planis utrinque molliter tomentosis integerrimis. [S. rostrata, *Hook. in Kew Jour. Bot. l. c.*]

Hab. Missouri v. Oregon, *Geyer*, coll. No. 286!

Priori valde similis, sed differt habitu toto, ramis interdum glaucescentibus, foliis (novella tantum vidi!) multo angustioribus, nec ullo modo obovatis, integerrimis, sed præcipue amentis fœm. triplo brevioribus subrotundis, nec cylindricis, et capsulis e basi valde crassa acutatis. Amenta mascula etiam breviora et crassiora; stamina magis aureofulva. Habitu amentorum propius ad *S. repentem* appropinquatur.

II. Virentes. Amenta sæpius pedunculata, foliis seu bracteis suffulta: capsulæ brevius pedicellatæ, stylo producto: folia exsiccatione non nigrescentia.

30. S. Drummondiana, *Barratt in Hook. Fl. Bor.-Am.* 2, *p.* 144.

Species pulcherrima, ramis elongatis nitidis castaneis vel rufis, amentis sessilibus, et capsularum forma, magnitudine, et indumento sequenti proxima et valde similis; sed differt abunde foliis (que iis *S. laurinæ* haud dissimilia) subtus vellere densissimo candido lanatis. Stylus in capsulis junioribus stigmatibus bifidis æquilongus, in capsulis adultis magis productus videtur, brevior tamen ac in *S. discolore.*

31. S. (phylicifolia) discolor. — S. discolor, *Muhl.; Hook. l. c.; J. Carey in Gray, l. c. p.* 414. S. phylicifolia, *J. Carey, l. c. p.* 416?

Specimina pleraque numerosa, quæ attente examinavi, parum differt a vera *S. phylicifolia,* qualis in Europæ alpestribus crescet vulgatissima et eximie polymorpha, eique saltem exacte analoga. Folia quam in nostra majora, adulta rigidiora et margine irregulariter sed non profunde repando-serrata, stipulæ in surculis et ramis novellis vegetis sat conspicuæ, amenta omnino præcocia, capsulæ angustæ sericeæ, et squamæ atræ longe pilosæ. In pluribus herbariis hæc species et *S. eriocephala* confusæ. Nullam aliam *S. phylicifoliam* ex America vidi, nisi forsan sequentem. — Nonne species apud nos loca alpina potissimum amans, quum in Americæ regiones magis temperatis inhabitat, hoc modo mutatur?

32. S. phylicoides, n. sp.: amentis subsessilibus elongatis crassi-

usculis; capsulis breve pedicellatis ovatis longe acutatis tenuissime pubescentibus; stylo elongato integro; stigmatibus brevissimis indivisis; foliis lanceolatis acuminatis basi angustatis margine integris subtus pallidioribus nec glaucis. — Forma LATIFOLIA: foliis 3 – 4-pollicaribus $1\frac{1}{2}$ poll. latis margine subsinuatis. Forma ANGUSTIFOLIA: foliis 1 – 2-pollicaribus $\frac{1}{2}$ poll. latis lanceolatis integerrimis.

Hab. in Arctica America occidentali (Avatscha Bay, *Seemann*, *Herb. Hook.*).

En aliam speciem mihi valde obscuram! Est ita inter *S. discolorem* et *S. cordatam* intermedia ut fere eodem jure ad quamvis ut subspecies relata esse possit. Cum priori congruit amentis longis, capsulis pubescentibus, stylo producto, foliis elongatis acutis basi angustatis; sed differt, capsulis multo brevius pedicellatis, stigmatibus indivisis, et foliis adultis vix rigidis nec subtus glaucis. Cum *S. cordata* communia habet stipulas basi latiores, folia subtus venulosa, et capsulas viridiusculas. — Folia 2 – 3-pollicaria: amenta fere eadem longitudine: capsulæ 2 – 3 lineas longæ.

33. S. MACROCARPA, *Nutt. in Herb. Hook.*: amentis pedunculatis foliatis erectis; capsulis breve pedicellatis conicis glaberrimis; stylo mediocri; stigmatibus integris; foliis exstipulatis lanceolatis integris glaberrimis subtus pallidioribus.

Hab. [Oregon? *Nuttall*] Hudson's Bay, *Burke*.

De hac specie iterum non parum sum incertus cui potissimum proxima censenda. Videtur frutex sat altus, ramis glabris. Folia iis *S. phylicifoliæ* simillima, $1\frac{1}{2}$ pollicem longa, semiunciam lata, acuta, basi acutata, matura rigidiuscula. Amenta fœminea pedunculo foliis 3 – 4 rite evolutis instructo infixa, pollicem longa, subramiflora. Capsulæ ut in *S. phylicifolia* nostra 2 lin. longa. — A præcedentibus longe differt amentis pedunculatis et foliatis: cum sequentibus non multa communia, nisi cum *S. glaucæ* formis denudatis.*

34. S. CORDATA, *Muhl.*; *Hook. l. c.*; *J. Carey in Gray*, *Man. p.* 415. In Europæ hortis non raro colitur salix hæcce pulchra, foliis magnis rigidis basi profunde cordatis, apice cuspidatis margine acute serratis, insignis. Qui hanc formam tantum inspexit vix ullam ejus affinitatem cum *S. hastata* nostra sibi fingeret, licet amenta, et mascula et fœminea

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* In his N. A. Sylva, 1, p. 67, Nuttall gives a character, but no figure, of this species. He calls it the "Western Pond Willow," and says it is closely related to *S. grisea*. He has omitted to mention the habitat. A. G.

huic omnino similia conspiciuntur, ceteras autem modificationes, quibus dilata est terra Americana usque ad septentrionem summum, quum videat, facillime intelliget has duas sibi valde esse analogas. Apud nos frutex *S. hastatæ* variat nunc orgyalis (in convallibus alpium), nunc (in campis alpium elevatis) repens, prostratus, et bidigitalis: folia sunt latissime ovata, acuminato-cuspidata, acute serrata, stipulis magnis cordatis ornata, nunc autem anguste lanceolata integra exstipulata. Prorsus eædem modificationes etiam ex America vidi, quare eas hoc modo serie analoga disponere vellem: —

S. hastata,	*S. cordata.*
malifolia, Sm.: foliis cordatis stipulis magnis, =	*rigida,* Muhl.
elegans, Hort: foliis ovatis, stipulis mediocris,	*myricoides,* Muhl.
alpestris, Fries: foliis lanceolatis, stipulis nullis,	*subarctica.*

S. cordata autem a *S. hastata* plerumque capsulis longius pedicellatis dignoscitur: cæterum omnibus partibus simillimæ, præsertim foliis rigidis subtus dense venulosis (character his speciebus valde singularis). Sub hac specie duas formas attulit Hooker, l. c.: 1. *S. balsamifera,* Barratt; 2. *S. Mackenziana,* Barratt. Quantum e speciminibus in herb. Hook. judicare possum *S. balsamifera,* cujus ramus foliis tectus tantum adest, ad *S. acutifoliam,* W. pertinet. Ramus cortice cœrulescenti-castaneo obductus. Stipulæ lanceolatæ, curvatæ; gemmæ magnæ acutæ; folia fere 4-pollicaria, semiunciam lata, argute sed remotiuscule serrata, subtus glaucescentia. *S. Mackenziana* mihi hybrida proles ex *S. cordata* et *S. vagante* (*rostrata*) videtur. A priori habet folia glaberrima, viridia, elongato-cuspidata, capsulas basi gibbas glabras, stylum brevem sed evidentem; a posteriori foliorum forma magnitudinem et consistentiam, capsulas longissime pedicellatas.

35. S. ADENOPHYLLA, *Hook. Fl. Bor.-Am.* 2, *p.* 146.

Est sine dubio *S. hastatæ* valde affinis: congruit enim cum ea, foliis subcordatis duris subtus reticulato-venosis argutissime serratis, stipulis magnis, pedunculis foliatis, capsularum forma et colore; sed differt abunde, foliis lana sericea densa primo obsitis, serraturis elongatis glanduligeris, capsulisque brevius pedicellatis.

36. S. MYRTILLOIDES, *L.* S. pedicellaris, *Pursh; Hook. l. c.; J. Carey in Gray, Man. l. c.*

Jam cl. Tuckerman, in The American Journal of Sciences and Arts, Vol. 45 (1843), p. 37, observavit speciem Americanam cum Lapponica valde congruere, nec possum quin ei omnino assentiar. Apud nos etiam species est vere elegantissima foliorum forma consistentia et colore, nec non capsulis statim ab omnibus dignata. In America adhuc magis luxurians videtur, folia nempe multo majora et ovalia. Ad nostram certissime se habet ut *S. rostrata* ad *S. depressam!*

III. Nigricantes, *Fries.*

37. S. Barclayi, n. sp.: pedunculo foliato; amentis incurvatis densifloris longe pilosis; capsulis glabris conicis in stylum longum integrum attenuatum productis, pedicello nectarium vix duplo superante; stigmatibus profunde bipartitis; foliis rotundato-ovalibus brevissime apiculatis supra parcissime pilosis vel glabriusculis subtus pallidioribus denudatis reticulato venulosis; stipulis ovatis acutis serratis.

Hab. in America boreali-occidentali: Kodiak, *Barclay* (*Herb. Hook.*).

Species ob id præcipue memorabilis, quod *S. hastatæ*, *S. nigricanti*, et *S. glaucæ* simul sit affinis. Cum *S. hastata* congruit, amentis pedunculatis, squamis longe cinereo-pilosis, capsulis obscure viridibus glabris, stylo producto, foliis subtus subglaucescentibus et pulcherrime reticulato-venulosis, stipulis denique latis serratis; cum *S. nigricante* habitu, foliis exsiccatione nigricantibus et subtus (sub lente) crebre albo-punctulatis; cum *S. glauca* capsulis subsessilibus, pedunculo foliis 5 – 6 cæteris subsimilibus instructo, et consistentia foliorum. Ob hanc variam affinitatem locus in dispositione methodica difficilis determinatu.

IV. Argenteæ, *Fries.*

38. S. Sitchensis, *Sans. ex Ledeb. Fl. Ross.* 3, *p.* 609.

Hab. in America boreali-occidentali: Sitcha, *Mertens;* Oregon, *Scouler;* et juxta Columbia River, *Hinds.*

Jam sub *S. brachystachya* observavi specimina *S. Sitchensis* in herbario Hookeriano *S. Scouleriana* appellata cum aliis esse confusa.

39. [S. sericea, *Marsh.; J. Carey in Gray, Man. l. c. p.* 414.] S. grisea, *Muhl.; Willd., etc.*

Locus in dispositione methodica ambiguus. *S. rubræ* nostræ primo subsimilis ob id ad Helices interdum ducta, ab iis amentis haud longe pilosis, staminibus discretis, et capsulis pedicellatis longe diversa. Amenta, præcipue mascula, parva subrotunda. Maxime affinis est sequenti, et per eam *S. repenti* nostræ.

40. S. PETIOLARIS, *Smith ; J. Carey in Gray, Man. l. c.*

Amentis et foliis præsertim junioribus *S. repenti* L. vel potius *S. rosmarinifoliæ* L. sat similis. Capsulæ, quæ in [*S. sericea*, Marsh. seu] *grisea*, Muhl. obtusissimæ et stigmatibus sessilibus coronatæ, in hac ovato-rostratæ stylo distincto apiculatæ : squamæ in priore obtusæ vel truncatæ, apice summo atratæ ; in hac acutæ, superne infuscatæ.

41. S. HUMILIS, *Marsh. ; J. Carey in Gray, Man. l. c.* S. Muhlenbergiana, Barratt, et S. conifera, *Muhl.* sec. *Gray, Man. l. c.*

E *S. cinerea* et *S. Smithiana* quasi composita videtur. Ab utraque foliis amentis et capsulis aliena. *S. tristis*, huic maxime affinis, aperte differt foliis utrinque opace cinereis, amentis fœmineis subglobosis, et capsularum stylo evidenti.

42. S. TRISTIS, *Ait. ; J. Carey in Gray, Man. l. c.* — Var. MICROPHYLLA : foliis semiuncialibus ; amentis globosis. Fruticulus parvus.

43. S. REPENS (*L.*?), *J. Carey in Gray, Man. p.* 418. S. fusca (*L.*), *Hook. l. c.*

Nullam veram *S. repentem* ex America in herbariis vidi. *S. repens*, Bigel. Fl. Bost. (*S. fusca*, Oakes) quum Tuckerman, l. c. *S. ambiguam* Ehrh. habet, ab utraque diversa, ad *S. arbusculam* referenda.

44. S. GRACILIS, *Anders.* (= S. rosmarinifolia (*L.*), *Hook. l. c. p.* 148) : amentis lateralibus bracteis paucis deciduis suffultis ; capsulis ovato-cylindricis obtusis tenuiter griseo-puberulis, pedicello nectarium octies superante ; squamis lingulatis apice infuscatis ; stigmatibus stylo brevissimo duplo longioribus integris ; foliis angusto-linearibus planis integerrimis basi longe angustatis latitudine fere decies longioribus subtus pallidis glabris.

Hab. Saskatchawan, *Drummond, Richardson.*

Var. ROSMARINOIDES : foliis apicem versus serrulatis marginibus acutiusculis subrevolutis. — Hab. Durham County [New Jersey ?], *Herb. Hook.*

Ab omnibus mihi cognitis speciebus bene dignoscitur foliis et capsulis. Quasi hybrida e *S. vagante* et *S. myrtilloide* videtur. A *S. rosmarinifolia* certissime longe recedit capsulis valde pedicellatis, a *S. vagante*, foliis linearibus elongatis. — Varietas, ut etiam nostra *S. gracilis* " *S. rosmarinifolia*, Barratt " inscripta, multo magis ad *S. rosmarini-foliam* veram accedit. Obstant autem capsulæ longissime pedicellatæ !

E. CHAMÆLIX, *Fries.*

I. Frigidæ, *Koch.*

45. S. glauca, *L.* — Hæc species in Lapponia et Silesia innumeris formis (*S. lanatæ, nigricanti, myrsinitidi* et aliis affinibus) ludens vulgatissima, et jam in Helvetiæ alpibus aliena facies (*S. sericea*, Vill. *S. albida* et *S. elæagnoides*, &c.) se induens, in arcticis regionibus Americæ habitu externo vix nostræ similis exstat. Specimina tamen a Seemann in parte occidentali et a Lyall in Disco Island lecta, necnon e Rocky Mountains reportata, cum nostris tamen ita congruunt ut de affinitate non dubitari licet. Folia nunc utrinque molliter villosa et incana, nunc denudata subviridia; amenta semper foliato-pedunculata; capsulæ brevius pedicellatæ. Huic certissime ut forma tantum associanda: —

Var. villosa (S. villosa, *D. Don?; Hook. l. c. p.* 144): foliis tenuioribus supra glaucis sparse pilosulis elevato-venosis; stipulis subpersistentibus lanceolato-linearibus; amentis sat longis erectis laxiusculis subramifloris; capsulis vix demum denudatis; stylo producto integro; stigmatibus brevibus cruciatis. — Hæc forma speciei maxime vegeta videtur. Etiam in Lapponia omnino similis occurrunt specimina (*S. glauca appendiculata*, Wahl.) ibique nullo crescendi modo a vera *S. glauca* distingui possunt.

* S. desertorum, *Richards.; Hook. l. c. p.* 151: amentis brevissimis (semipollicaribus) subglabris densifloris; capsulis ovatis dense lanatis squamis ovalibus maxima parte obtectis; stylo bipartito fusco; foliis anguste oblongis rigidis subtus plus minus albo-tomentosis subglaucescentibus costa prominente flava et nervis elevatis subscrobiculatis supra sæpius viridibus lucidis.

Insignis sane ut forma in orbe vetere quantum scio nondum observata. Fruticulus videtur 1–2-pedalis: rami breves, robusti, foliis et amentis condensatis onusti. Squamæ sat magnæ capsulas magnam partem occultantes. Stamina fulvo-aurea. Folia iis *S. repentis* haud absimilia. Transitus autem ad normalem *S. glaucam* nonnunquam reperti. Videtur itaque hujus modificatio maxime frigida.

Monstrositatem hujus formæ, ex Minto Inlet ab Anderson lectam, vidi, ramis elongatis foliatis apice spicigeris aberrantem.

46. S. arctica, *R. Br.; Hook. l. c. p.* 152.

Species sane difficilis determinatu, quasi inter *S. Myrsinitidem* et *glaucam* prorsus media, et formas plures ambiguas amplectens. A *S. Myrsinite* habet amenta plus minus elongata et spissa, squamas vulgo infuscatas, stylos semper longos, tenues, piceos vel atros, integros; a *S. glauca* folia tenuiora virescentia, plus minus hirsuta, capsulas incano puberulas. Ab utraque tamen differt, trunco procumbente ("frutex depressus," *Br.*), ramis adscendentibus, foliis sparsis longius petiolatis vere herbaceis vulgo obovatis integris, venis parum elevatis rugulosis, subtus glauco-opacis, amentis utriusque sexus spurie terminalibus, i. e. ramulos breves villosos foliatos terminantibus. Vereor ne sub nominibus variis (*S. Myrsinites, S. retusa, S. ovalifolia, S. polaris,* etc.) formæ variæ hujus speciei ab auctoribus sæpe descriptæ sint? Notabiliores sunt:

Var. SUBPHYLICIFOLIA: foliis angustatis acutatis utrinque glabriusculis. — Hab. Norton Sound, *Seemann.*

Var. SUBRETICULATA: trunco et ramis longe procumbentibus apice tantum foliiferis; foliis elongato-obovatis glabriusculis subtus reticulato-venulosis; amentis (terminalibus) 2 – 3-pollicaribus. — Hab. Hudson Bay, Mackenzie River, etc.

Var. SUBPOLARIS: biuncialis; ramis apice folia 3 – 5 emittentibus quibus conditur amentum semipollicare; squamis atris truncatis emarginatis. Hab. in litore maris arctici (Minto Inlet, *Anderson*).

S. obovatam, Pursh (Hook. herb.) a *S. arctica* distinguere nequeo.

47. S. SUBCORDATA, *Anders.* = S. cordifolia, *Pursh, Hook. l. c. p.* 152, p. p. (altera pars ad *S. alpestrem* pertinet!): amentis lateralibus pedunculatis foliatis; capsulis sericeis ovatis sessilibus; stylo bifido; stigmatibus partitis divaricatis; foliis rotundatis seu ovalibus basi cordatis vel subangustatis utrinque glabris subtus pallidis viridibus venoso-reticulatis herbaceis stipulatis.

Hab. "Rocky Mountains," *Drummond.*

Frutex parvus, ramis erectiusculis nitidis castaneis, gemmis magnis. Folia adulta sæpe biuncialia, longe petiolata (petiolo flavo lucido), costa et nervis subtus prominentibus reticulata, margine obsolete glanduloso-serrulata: stipulæ cordatæ. Amenta semipollicaria, crassiuscula. Quoad habitum quasi hybrida a *S. cordata* (cujus folia habet, sed breviora) et *S. glauca* (amenta!).

48. S. ALPESTRIS, *Anders.*: amentis vel pseudo-terminalibus pedunculatis foliatis; capsulis subsessilibus ovatis albo-tomentosis vel subglabratis; nectario vix basin capsulæ superante; stylo producto sæpe ad

medium fisso; stigmatibus bifidis, laciniis revolutis; foliis oblongis vel subovalibus vel obovatis ut plurimum villosis demum glabratis. — Hoc nomine formas varias comprehendo, quæ, ad unam speciem certissime referendæ, in variis terris suis nominibus appellatæ fuerunt. Sunt: —

a. Pyrenaica. S. Pyrenaica, *Gouan!* In alpibus Pyrenæis.

β. Helvetica. In Helvetia.

γ. Norvegica. S. Pyrenaica var. Norvegica, *Fries.* In Scandinaviæ alpibus (Norvegia et Lapponia).

δ. Americana. S. cordifolia (*Pursh*), *Hook. l. c. p.* 152, pro parte. In arctica America.

Ab omnibus *S. glaucæ* formis, etiam Pyrenæis, differt trunco subterraneo, ramis subprostratis vel adscendentibus, foliis brevioribus apice obliquo, rigidioribus (ut *S. Myrsinitidem* eo respectu fere simulat), subtus venis elevatis rugulosis, demum glabratis sed margine fere semper ciliatis, amentis laxioribus omnino coetaneis foliis pluribus suffultis, et capsulis distinctius pedicellatis. Iisdem notis a *S. subcordata* recedit: a *S. rhamnifolia* et *S. ovalifolia* foliis utrinque acutis velutinis vel saltem ciliatis, amentis longis et foliatis, capsulis plerumque villosis.

49. S. Myrsinites (*L.*), *Hook. l. c. p.* 151. — Quum rite extricare nequeo quam speciem ill. Hooker, l. c. potissimum intellecuit, specimina quæ in herbario ejus asservantur et mihi valde dubia restant, describenda puto:

* S. Pseudo-myrsinites, *Anders.:* amentis lateralibus foliis paucis bracteatis erectis elongatis densifloris; capsulis pedicellatis conicis glaberrimis testaceis; stylo distincto; stigmatibus brevibus; pedicello squamam duplo et nectarium quadruplo superante; foliis oblongo-lingulatis breve petiolatis tenuiter membranaceis utrinque glaberrimis, subtus subpallidioribus costa et venis prominulis nervosis crebre et depresse serrulatis.

Hab. "Grand Rapids of the Saskatchawan" et "Rocky Mountains." Frutex parvus, 1 – 3-pedalis, ramis divaricatis, foliis $1\frac{1}{2}$-pollicaribus vix semipollicem latis (habitu fere *S. Myrsinitidis* nostræ, sed minus coriaceis nec ita venulosis et argute serratis). Amenta (fere ut in *S. phylicifolia*) bipollicaria. Capsulæ testaceæ.

* S. curtiflora, *Anders.:* amentis breve pedunculatis foliis 3 – 4 minutis suffultis erectis brevibus ovatis glaberrimis viridulis; stylo distincto; stigmatibus brevissimis conniventibus; pedicello squamam

atram apice crispato-hirsutam triplo et nectarium parvum quadruplo superante ; foliis anguste ovalibus utrinque glabris exsiccatione nigricantibus margine crenulatis.

Hab. "Fort Franklin, Mackenzie River," *Richardson*.

A vera *S. Myrsinitide* longe distat, habitu potius *S.* (*cordatæ*) *hastatæ* vel immo *S. nigricanti* magis affinis. Fruticulus parvus: rami vix pedales: folia semipollicaria 2 lin. lata, subtus punctis albis creberrimis subpallidiora. Amenta semipollicaria: rhachis puberula: capsulæ minutæ, viridulæ.

50. S. ARBUSCULA, *L.?* S. Myrsinites (*L.*), *Hook. l. c. p.* 151, pro parte.

Formæ quas in "Prince Albert's Land (H. M. S. Investigator)" et "Rae River" (*Dr. Rae*) in herb. Hook. vidi a specie nostra alpina differunt, foliis adhuc angustioribus, squamis amenti apice fuscis, capsulis subtenuioribus, et stigmatibus subsessilibus. Non possum etiam quin ad hanc speciem illam referam formam quam cl. Tuckerman (in *Amer. Jour. Science*, 45, *p.* 35) ut *S. ambiguam*, Ehrh. descripsit (= *S. repens*, herb. Oakes). In Europa ill. Wimmer hanc speciem e *S. repente* et *S. aurita* (quæ forsan in America non inventæ !) prolem hybridam habet. Amentis pedunculatis foliatis, squamis capsulas basi tegentibus flavidis, stylo producto, foliis lingulatis integerrimis, et habitu toto ab omni *S. ambigua* dignoscitur. Ab *S. arbuscula* tamen recedit foliis pilis longis adpressis subtus dense sericeis et integerrimis. Huc etiam referenda:

Var. LABRADORICA: foliis pollicaribus 3 lin. latis costa lata flavescente subtus notatis margine sæpe remote serratis subtus parcissime pilosis. — Labrador.

51. S. RHAMNIFOLIA (*Pall.?*), *Hook. & Arn. Bot. Beech. Voy. p.* 117, *t.* 26 ; *Ledeb. Fl. Ross.* 3, *p.* 612. S. Uva-Ursi (*Pursh*), *Hook. l. c. p.* 152, pro parte ? S. Myrsinites, *Cham. & Schlecht. in Linnæa*, 6, *p.* 540 (ad sinum Sti Laurentii). S. myrtilloides, formæ 1, 2, *Cham. l. c. p.* 539. — Huc forsan etiam pertinet *S. Unalaschensis*, Cham. l. c. p. 541, quæ tamen nostræ *S. hastato-herbaceæ* non dissimilis (sed folia integra !), *S. rhamnifoliam* et *S. ovalifoliam* quodammodo connectit.

Nomen *S. Uva-Ursi*, Pursh, quod in herbario Hook. a Barratt huic speciei etiam impositum est, plane rejiciendum: 1. quod Pursh ipse specimina culta et nunc valde incerta descripsit; 2. quod speciebus pluribus aliis ex "White Mountains of New Hampshire" et Labrador valde recedentibus, fere eodem jure (si mancam diagnosin Purshii respicias) datum fuit. — Cum speciminibus S. *rhamnifoliæ* a Hooker, l. c. primum descriptis et depictis nostra non male congruunt; sed recedunt nonnihil foliis vix spathulato-obovatis margine subintegris, capsulis crassioribus et brevius pedicellatis. Sunt quasi inter S. *Myrsinitidem* (cui capsulis subsimilis) et S. *arbusculam* (cui foliis) disponenda!

52. S. OVALIFOLIA, *Trautv.; Ledeb. Fl. Ross*, 3, *p.* 620. S. Uva-Ursi, *Seemann, Bot. Voy. Herald. p.* 40. S. myrtilloides, forma 4, *Cham. l. c. p.* 539.

Var. MAJOR: ramis magis elongatis; foliis majoribus elongato-obovatis acutiusculis subtus minus glaucescentibus; amentis fœmineis crassioribus; capsulis majoribus. S. myrtilloides forma 3, *Cham. l. c. p.* 539.

Hab. ad sinum Eschscholtz et Cap. Espenberg (*Chamisso* et *Espenberg*); in insula Sancti Pauli (*Chamisso*); America occidentali-boreali (*Seemann*).

A cæteris facile distinguitur ramis flabellatim procurrentibus, foliis $\frac{1}{2}-\frac{3}{4}$ pollicem longis, vix eadem latitudine, ovalibus vel subrotundis, glabris, rigidiusculis, subtus opace reticulato-venosis, amentis foliis fere duplo brevioribus densifloris, squamis castaneis apice rotundato infuscatis capsulas rufo-piceas glabras attenuatas ad medium tegentibus, stylo distincto, stigmatibus bifidis.

53. S. GLACIALIS, n. sp.: amentis in ramulis annotinis lateralibus foliatis pedunculatis ovato-globosis; capsulis ovatis sericeis sessilibus squamam obovatam vel truncatam duplo superantibus obtusissimis; stylo nullo; stigmatibus bifidis; foliis ovalibus glabris subtus glaucis integerrimis.

Hab. in litore maris glacialis; "between Cape Barrow and Mackenzie River," *Capt. Pullen.*

Hæc species, a Seemann, l. c. S. *Uva-Ursi* etiam subsumta, a priori statim dignoscitur foliis multo minoribus (vix $\frac{1}{4}$ unciam longis vel latis), fere omnino rotundatis, omnino integerrimis, basi latioribus fere subcordatis (quæ etiam in herb. Hook. "S. *myrtilloides*" inscripta), amentis duplo brevioribus, capsulis sericeis, et stigmatibus sessilibus. Radix (truncus subterraneus) latissime repens; rami horizontaliter decumbentes, subdigitales.

II. GLACIALES.

54. S. (RETUSA) PHLEBOPHYLLA, *Anders.* S. retusa (*L.*), *Hook. l. c. p.* 153; *Seemann, l. c. p.* 40.

Forma MAJOR. Folia obovata, integerrima, semiunciam longa, supra medium fere eadem latitudine, supra planiuscula, subtus nervis arcuatis elevatis striata, exsiccatione fusco-viridia: amenta pollicaria densiflora: squamæ parvæ, ciliatæ: capsulæ ovato-conicæ, glaberrimæ, rufæ, pedicellatæ, pedicello squamam parum et nectarium fere duplo superante: stylus pedicelli dimidia longitudine. Hab. in America occidenti-boreali (*Seemann*).

Forma MEDIA. Folia oblonga vel subovalia basi subangustata, semiunciam longa, 3 – 4 lin. lata, nervis elevatis subarcuato-parallelis utrinque costata: amenta semipollicaria, crassa, subclavata: squamæ obovatæ, atræ, longe albo-pilosæ, basin capsulæ attingentes: capsulæ e basi crassa conico-rostratæ, glaberrimæ, rufescenti-sanguineæ, pedicello nectarium vix superante: stylus pedicello longior, tenuis, integer: stigmata bifida, divaricata. Hab. Cap. Mulgrave, *Beechey*. Arctic coast, *Richardson*.

Forma MINOR. Folia ovalia seu oblonga, 2 – 3 lin. longa, nervis rectiusculis parallelis validis percursa (qui nervi, diachymate mox toto evanescente, retis instar soli persistunt): amenta minuta, foliis apicalibus abscondita: capsulæ glaberrimæ, rufescentes, subsessiles, stylo mediocri.

Has tres formas, inter se non parum dissimiles, nullo modo distinguere valeo, quia seriem contiguam a statura majori ad minimam pusillam efficiunt. Est semper fruticulus depressus; ramis ad maximum digitalibus plerumque valde foliatis. A vera *S. retusa*, qualem ex Helvetia bene cognosco, certe quidem nonnihil differt: hæc etiam eandem habet seriem formarum a *S. Kitaibeliana*, Willd. (foliis majoribus) ad *S. serpyllifoliam*, Jacq. (foliis perpusillis) toto habitu consistentia et nervatione foliorum huic nostræ omnino analoga. Forma major maxime ad *S. rhamnifoliam* habitu fruticuli et foliorum accedit, sed differt, amentis exacte terminalibus, foliis nunquam serrulatis adhuc rigidioribus.

55. S. CUTLERI, *Tuckerman in Amer. Jour. Sci.* 45, *p.* 36. S. Uva-Ursi, *J. Carey in Gray, Man. p.* 418.

Forma MAJOR: foliis obovato-ovalibus fere semipollicaribus; amentis pollicaribus.

Forma MINOR: foliis 3 lin. longis adhuc angustioribus oblongis; amentis semipollicaribus.

In speciminibus a me examinatis (et a Tuckermano ipso communicatis) amenta semper terminalia; mascula (quorum stamina singula describuntur) non vidi: nonne ob staturam humillimam et compactam depauperata? Cum *S. retusa* Europæ meridionalis plane nihil commune habet: potius modificatio maxime alpina *S. myrtilloides* (*S. pedicellaris* Amer.) esset judicanda?

56. S. MYRTILLIFOLIA, n. sp.: amentis in ramulis annotinis terminalibus foliis occultatis vix semipollicaribus; capsulis brevissime pedicellatis minutis læte viridibus glaberrimis anguste conicis, pedicello squamam angustam apice nigram glabriusculam subæquante; stylo subnullo facile caduco; stigmatibus brevissimis integris; foliis semiunciam longis 3 lin. latis ovalibus utrinque pallide viridibus et glaberrimis margine crenulato-serrulatis, novellis tenuitate nigrescentibus.

Hab. "Rocky Mountains, east side, in low situations," *Herb. Hook.*

Fruticulus trunco parvo superne ramoso, ramis strictiusculis fere omnino ut in Myrtillo nigro, cui insuper foliis pare viridibus tenuibus margine crenulatis ovali-subrotundis eximie similis.

57. S. RETICULATA, *L.; Hook. Fl. Bor.-Am.* 2, *p.* 151.

Var. *a.* VESTITA (S. vestita, *Pursh: Hook. l. c. p.* 152): foliis subtus pilis longis deciduis sericeis.

Forma GRANDIFOLIA: frutex fere bipedalis; ramis strictissimis; foliis 2 pollices longis supra medium $1\frac{1}{2}$ poll. latis subtus demum omnino glabris; amentis fere bipollicaribus. (Etiam in Siberia.)

Forma PARVIFOLIA: fruticulus, ramis adscendentibus; foliis oblongo-ovalibus subtus densissime albo-sericeis. (Etiam in Helvetia.)

Var. *β.* NORMALIS. S. reticulata, *L.* Qualis in Europæ alpibus vulgaris.

Var. *γ.* NANA (S. nivalis, *Hook. l. c. p.* 152): pygmæa; ramis subdigitalibus; foliis 2 – 4 lin. longis latisque subtus etiam omnino nudis cæsio-albis pulchre venuloso-reticulatis; amentis linearibus e floribus 3 – 6 compositis; squamis obovato-rotundatis glabris venosis. (Etiam in Grœnlandia et Spitzbergen.)

Qui hybridas formas etiam sponte facile procreatas credit formam grandifoliam *S. vestitæ*, s. d. e *S. reticulata* et *S. lanata*, et *S. nivalem*, s. d. e *S. reticulata* et *S. herbacea* ortam conjiciat. Formis innumeris hæ extremæ inter se connexæ nullo modo speciei distingui possunt.

58. S. HERBACEA, *L.; Hook. l. c. p.* 153; *Gray, Man. l. c.*

59. S. POLARIS, *Wahl.: Hook. l. c. p.* 153.

I have omitted from this enumeration the *S. Babylonica*, which is occasionally planted for ornament.

Our list of Willows of North America (exclusive of Mexico, &c.) amounts to fifty-eight species [not counting No. 42, *S. repens*], or rather to fifty-nine, as two are proposed under *S. Myrsinites*; while the Scandinavian species, including almost all the European, probably do not exceed forty-five. These fifty-nine American species, when compared with the European as to their affinities, may be classified into the following five groups: —

I. Those which are common both to the Old and to the New World.

a. Perfectly identical, although more variable in America than in Europe.

1. Transplanted from Europe for cultivation:

S. alba,	*S. fragilis*,	*S. acutifolia*,
S. viridis,	*S. purpurea*,	*S. viminalis*.

2. Arctic or Alpine species:

S. vagans,	*S. reticulata*,	*S. arbuscula*,
S. myrtilloides,	*S. herbacea*,	*S. polaris*.

b. Having forms very little differing from the European:

(*S. cinerea ?*),	*S. glauca*,	*S. arctica*,
S. Lapponum,	*S. lanata*,	*S. alpestris*.

II. Those which, very widely distributed in the middle parts of North America, appear so analogous to European species that they (or at least some of their forms) cannot be definitely distinguished from them, and so may be considered as subspecies:

S. lucida,	analogous to	*S. pentandra*.
S. irrorata,	"	*S. daphnoides*.
S. phylicoides,	"	*S. phylicifolia*.
S. cordata,	"	*S. hastata*.
S. capreoides,	"	*S. Caprea*.
S. phlebophylla,	"	*S. retusa*.

III. Those which differ sufficiently in characters from their European relatives to be considered as distinct species, though belonging to types which in the Old World produce fewer forms:

S. Fendleriana,	related to	*S. pentandra*.
S. Wrightii,	"	*S. alba*.
S. amygdaloides,	"	*S. amygdalina*.

S. eriocephala,	related to	*S. daphnoides.*
S. brachystachys,	"	*S. aurita.*
S. discolor, *S. macrocarpa,*	"	*S. phylicifolia.*
S. Geyeriana,	"	*S. vagans.*
S. humilis, *S. tristis,*	"	*S. repens.*
S. gracilis,	"	*S. rosmarinifolia.*
S. subcordata,	"	*S. glauca.*
S. Pseudo-Myrsinites, *S. curtiflora,*	"	*S. Myrsinites.*
S. Cutleri,	"	*S. myrtilloides?*

IV. Those which also manifestly represent European types, but with more marked specific differences than those under the preceding head:

S. Bigelovii, *S. lasiolepis,* *S. Coulteri,*	belonging to	the type	of	*S. daphnoides.*
S. Hookeriana, *S. speciosa,*	"	"	"	*S. lanata.*
S. candida,	"	"	"	*S. Lapponum.*
S. Drummondiana,	"	"	"	*S. laurina.*
S. adenophylla,	"	"	"	*S. hastata.*
S. Barclayi,	"	"	"	*S. glauca.*

V. Those which form peculiarly American types:

1. *S. longifolia, S. sessilifolia* (* *Hindsiana* and *S. taxifolia*). Correspondents in Europe, *S. riparia* and its allies. To which may be added *S. nigra* and *S. longipes,* belonging to a type peculiar to southern or tropical countries.
2. *S. Sitchensis, S. serica* (*grisea*), and *S. petiolaris;* compensations, as it were, in America, for our *Salices mollissimæ* and *repentes.* (*S. angustifolia,* Wulf., is by Wimmer and others regarded as a hybrid of *S. repens* and *S. viminalis.*)
3. *S. rhamnifolia, S. ovalifolia, S. glacialis,* and *S. myrtillifolia,* — purely arctic forms, corresponding only with species from northern or arctic Siberia.

From all this we gather, that, of the fifty-eight species growing in North America, there are

12 identical with European species.*
6 nearly identical with European species.
6 very analogous to European species.
15 very distinct species, but of European types.
9 species almost peculiar to America.
10 species quite peculiar to America.

If now, on the other hand, we examine the Scandinavian species and types, to ascertain which of them are wanting in America, we find the following, viz.: —

1st. 8 species more or less cultivated throughout Europe, and probably of a more southern origin: *S. undulata*, (*hippophæifolia*,) *rubra*, (*mollissima*,) *lanceolata*, *Smithiana*, (*stipularis*,) (*holosericea*). Four of these (in parentheses) are regarded as hybrids by some botanists.

2d. Only one species indigenous to Scandinavia, where, as in Switzerland, it forms such a multitude of varieties that Schleicher has founded nearly a hundred species upon this one, — viz. *S. nigricans*, a truly European species; of which *S. canescens*, *S. versifolia*, and *S. ambigua* are by many botanists thought to be hybrid forms.

To these may be added from the rest of Europe: *S. Silesiaca*, almost peculiar to Silesia; *S. glabra*, of the Austrian Alps; *S. grandifolia* and *S. Seringiana*, of Switzerland; *S. riparia*, *S cæsia*, and *S. pedicellata*, in Italy and Spain.

It appears, therefore, that of the 58 North American species, 24 are identical with European ones; 24 belong to the same types; and only 10, western or arctic forms, seem to be peculiar to this great continent: and further, that of the Scandinavian flora only a single indigenous species or type is not yet found in America (a type which appears as if composed of almost every other); while 48 more or less related species or types are common to the New and the Old World, but more luxuriant and varying in America, where we also find a number of other types. All this leads us to look to America as the chief abode, perhaps the original home, of the Willows, and the country where the genus ought to be especially studied. Therefore we may call upon American botanists to apply themselves to the investigation of this genus and its intricate forms, as they have already done to another vast genus (*Carex*) which presents an analogous distribution.

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* Half of these were imported from the Old World, and are cultivated or naturalized, as already stated on p. 75. A. G.

Science, which prefers facts to hypotheses, has not yet sufficient materials to assure us whether, and by what means or in what ways, the original species were first diffused from single centres over distant parts of the earth; but all we know of the arctic and northern regions shows that their vegetation is very homogeneous. This synopsis may help to show, with regard to Willows, that there are many links connecting Europe and America.

[NOTE. — There are about ten species of *Salix* from Oregon and the Rocky Mountains described, and two or three of them figured, in Nuttall's North American Sylva, which remain unknown to Prof. Andersson: all or most of them he may be able to identify, when the volume reaches him, with species enumerated in this Synopsis. A. G.]

Four hundred and fifty-first meeting.

May 11, 1858. — MONTHLY MEETING.

The Academy met at the house of B. A. Gould, Esq.

The PRESIDENT, and afterwards the VICE-PRESIDENT, in the chair.

The Corresponding Secretary read the following letters, viz.: — From the Académie des Sciences, etc. de Dijon, January 18, 1857; Société des Sciences Naturelles de Cherbourg; Det Kongelige Danske Videnskabernes Selskab, June 30, 1857; K. Akademie der Wissenschaften, Wien, August 10, 1857; Royal Society of Sciences, Upsal, October 11, 1857; Société Linnéene de Normandie, November 29, 1857; Trustees of Boston Athenæum, April 10, 1858; and the Boston Society of Natural History, May 1, 1858, acknowledging the receipt of the Academy's publications; — from the Director der Sternwarte, Breslau, October 23, 1857, in acknowledgment of the same, and presenting a work on Climatology; — from the Académie des Sciences de Dijon, January 18, 1857; Det Kongelige Danske Videnskabernes Selskab, June 30, 1857; K. Academie der Wissenschaften, Wien, December 17, 1857; Université Royale de Christiania, November 10, 1857; Nicholas Manzini, Havana, December 10, 1857; and Colonel J.

D. Graham, U. S. A., Chicago, May, 1858, presenting their various publications; — and from the Royal University of Christiania, Norway, November 7, 1857, presenting a medal in honor of Christopher Hansteen.

Mr. Sherwin made a communication upon a curious property of numbers. He also spoke, in the way of inquiry, of the supposed low temperature of water at a great depth in the ocean.

Mr. F. H. Storer doubted the fact of such a low degree of temperature under these circumstances; he thought the indications of the self-registering thermometer were not reliable.

Mr. Folsom exhibited a stone slab bearing a Latin inscription of the date of 1703. Part of the stone was wanting; but Mr. Folsom made a conjectural restoration of the missing portion of the inscription. It related to Castle William, in Boston Harbor. It was found by Mr. Folsom in the attic of the old Athenæum building, in Pearl Street.

Professor Lovering referred to the laying down of the Oceanic Telegraph cable between England and America, and gave an account of Captain Blakely's strictures upon the method pursued, which overlooked the great resistance of the water to the stretching of the cable straight, and the necessity, which followed from this resistance, of the vertical descent of each point of the cable, and its being slack on the bottom, and of the length therefore *required* exceeding that originally calculated.

Dr. W. F. Channing followed in some remarks, speaking particularly of the retardation of the current by the sheathing of iron wire.

Professor Horsford described a method of illustrating the interference of the waves of sound, used by Mr. Gould, a student in the Cambridge Scientific School. A tuning-fork was held over a vessel, the length of which was changed by pouring in water until it was in tune with the fork. While the fork is vibrating, it is turned round on its long axis.

DONATIONS TO THE LIBRARY,

FROM APRIL 25, 1857, TO APRIL 16, 1858.

D. F. L. von Schlechtendal.

Linnæa, Ein Journal für die Botanik in ihrem ganzen Umfange. Band XXVII. Heft 5 und 6. Band XXVIII. Heft 1 – 3. 8vo. Halle. 1855 – 56.

Natural History Society of the Prussian Rhineland and Westphalia.

Verhandlungen. XIII. Jahr, Heft 2, 3, und 4. XIV. Jahr, Heft 1. 8vo. Bonn. 1856 – 57.

Royal Bohemian Society of Science.

Abhandlungen. 5e Folge. 9er Band von den Jahren 1854 – 56. 4to. Prag. 1857.

Denkrede auf Prof. Franz Adam Petrina. Vorgetragen in der Sitz. der Naturw.-Math. Section der Kön. Böhm. Gesell. der Wiss. am 10 Dec. 1855. Von Dr. Wilhelm Rudolph Weitenweber. 4to pamph. Prag. 1856.

Bericht über ein bisher unbekanntes rechtsphilosophisches Manuscript eines österreichischen Verfassers. Von Dr. Robert Zimmermann. 4to pamph. Prag. 1855.

Der Arabische Kaffee in naturgeschichtlicher, chemischer, diätetischer und ärztlicher Beziehung für Aerzte und Nichtärzte geschildert von Dr. W. B. Weitenweber. 1 vol. 16mo. Prag, etc. 1857.

Society for the Improvement of Horticulture in the Prussian States.

Verhandlungen. Neue Reihe. III. Jahr, Juli bis Dec. 1855. IV. Jahr, Jan. bis Jun. 1856. 8vo. 2 pamph. Berlin. 1856.

Dr. M. N. Joly.

J. A. Glazes et Le Regime des Herbes. Étude Biographique, Littéraire, et Physiologique. 8vo pamph. Toulouse. 1856.

Imperial Society for the Acclimation of Animals.

Bulletin. Tome IV. Nre 3 – 12. Tome V. Nre 1 et 2. 8vo. Paris. 1857 – 58.

Observatory of Königsberg.

Astronomische Beobachtungen auf der Königlichen Universitäts Sternwarte zu Königsberg. Abth. 28 und 30. Folio. Königsberg. 1856 – 57.

Netherlands Government.

Flora Batava. Afl. 181. 4to. Amsterdam.

Royal Academy of Sciences, Amsterdam.

Verhandelingen der Konink. Akad. van Wetten. Deel III. 4to. Amsterdam. 1856.

Verslagen en Med.-Afd. Phys.-Math. Deel III. Stuk 3; Deel IV.; Deel V. Stuk 1.—Afd. Letterkunde. Deel I.; Deel II. Stuk 1. 8vo. Amsterdam. 1856.

Lycidas Ecloga et Musæ Invocatio, Carmina quorum Auctori Johanni van Leeuwen, e Vico Zegwaart Certaminis Poetici Præmium secundum e Legato Jacobi Henrici Hoeufft adjudicatum est. 8vo pamph. Amstelodami. 1856.

Dr. Carl Rokitansky.

Lehrbuch der Pathologischen Anatomie. Zweiter Band. 8vo. Wien. 1856.

Royal Bavarian Academy.

Abhandlungen der Philos.-Philol. Classe der Königl. Bayerisch. Akad. der Wissenschaften. Band VII. Abth. 1. 4to. München. 1856.

Gelehrte Anzeigen. Bande XLII. und XLIII. 4to. München. 1856.

Royal Society of Sciences, Upsal.

Nova Acta Regiæ Societatis Scientiarum Upsaliensis. Vol. XIV. Pars II. 4to. Upsal. 1850.—Seriei Tertiæ, Vol. II. Fasc. Prior. 4to. Upsaliæ. 1856.

Royal Society of Sciences, Leipzig.

Abhandlungen der Kön. Säch. Gesell. der Wissenschaften.—Math.-Physisch. Classe. Band V. pp. 379 - 682.—Philolog. Historisch. Classe. Band III. pp. 509 - 922. Royal 8vo. Leipzig. 1856 - 57.

Imperial Mineralogical Society, St. Petersburg.

Verhandlungen der Russ. Kaiserl. Mineral. Gesell. zu St. Petersbourg. Jahr. 1854 - 56. 8vo. St. Petersbourg. 1855 - 56.

Imperial Academy of Sciences, St. Petersburg.

Mémoires. VI^{me} Serie. Sciences Politiques, Histoire, Philologie. Tome VIII. 4to. St. Petersbourg. 1855.—VI^{me} Serie. Sciences Mathematiques, Physiques, et Naturelles. Tome IX. Seconde Partie. Sciences Naturelles. Tome VIII. 1 vol. 4to. St. Petersbourg. 1855.

Mémoires Présentés à l'Acad. Imp. des Sciences, par divers Savants et lus dans ses Assemblées. Tome VII. 4to. St. Petersbourg. 1854.

Compte Rendu de l'Académie. Années 1852 – 55. 3 vols. 8vo. St. Petersbourg. 1853 – 56.

Administration of Mines of Russia.

Compte Rendu Annuel. Addressé à S. Exc. M. de Brock, Ministre des Finances, par le Directeur de l'Observatoire Physique Central, A. T. Kupffer. Année 1855. 4to. St. Petersbourg. 1856.

Imperial Society of Naturalists in Moscow.

Nouveaux Mémoires de la Société. Tome X. 4to. Moscou. 1856.

Bulletin de la Société. Année 1855, Nre 3 et 4. Année 1856, Nre 1. 8vo. Moscou. 1855 – 56.

Natural History Society in Emden.

Kleine Schriften. Die Gewitter des Jahres 1855. Von Dr. M. A. Prestel. 8vo. Emden. 1856.

L. A. Huguet Latour.

Report of the Commissioners of Public Works of Canada for the Year ending 31st December, 1855. 1 vol. 8vo. Toronto. 1856. [Legisl. Doc.]

American Oriental Society.

Journal. Vol. V. No. 2. 8vo. New York. 1856.

Charles F. Barnard.

Proceedings of the Twentieth Annual Meeting of the Association for the Support of the Warren Street Chapel. 12mo pamph. Boston. 1857.

Royal Society of London.

Philosophical Transactions for the Year 1856. Vol. CXLVI. Parts 2 and 3. 4to. London. 1856.

Proceedings. Vol. VIII. Nos. 23 and 26. 8vo. London. 1856 – 57.

List of the Fellows of the Royal Society, 30th November, 1856. 4to. London.

Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Year 1855, under the Superintendence of Manuel J. Johnson, M. A., Radcliffe Observer. 8vo pamph. Oxford. 1856.

Catalogue of Stars near the Ecliptic, observed at Markree during the Years 1854 – 56, and whose Places are supposed to be hitherto unpublished. Vol. IV. containing 14,951 Stars. 8vo. Dublin. 1856.

Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the Year 1855, under the Direction of George Biddell Airy, Esq., M. A., Astronomer Royal. 1 vol. 4to. London. 1857.

Isaac Lea, LL. D.

Descriptions of Four New Species of Exotic Uniones, and Thirteen of Exotic Melaniania. Description of the Byssus of the Genus Unio, etc. 8vo pamph. Philadelphia. 1857.

Observations on the Genus Unio, together with Descriptions of New Species in the Family Unionidæ. Vol. VI. Pt. I. 1857. 4to. Philadelphia. 1857.

Major Benjamin Alvord, U. S. A.

The Tangencies of Circles and of Spheres. 4to pamph. Philadelphia. 1856. [Smithsonian Contributions to Knowledge.]

Alexis Jordan.

Nouveau Mémoire sur la Question relatif aux Ægilops triticoides et speltæformis. 8vo pamph. Paris. 1857.

Dr. N. B. Shurtleff.

Fourteenth Report to the Legislature of Massachusetts, relating to the Registry and Returns of Births, Marriages, and Deaths, in the Commonwealth, for the Year ending Dec. 31, 1855. By Francis DeWitt, Secretary of the Commonwealth. 1 vol. 8vo. Boston. 1857.

Abstract of the Census of the Commonwealth of Massachusetts, taken with Reference to Facts existing on the First Day of June, 1855, with Remarks on the same. Prepared under the Direction of Francis DeWitt, Secretary of the Commonwealth. 1 vol. 8vo. Boston. 1857.

American Philosophical Society.

Transactions. New Series. Vol. XI. Part I. 4to. Philadelphia. 1857.

Proceedings. Vol. VI. Nos. 57 and 58, Jan. to June, and July to Dec., 1857. 8vo. Philadelphia.

B. A. Gould, Jr., P. D.

Astronomical Journal. Vol. V. Nos. 7–16. 4to. Albany. 1857–58.

Edouard Desor.

Une Dernière Ascension. 8vo pamph. Neuchatel. 1854.

Du Climat des Etats-Unis et de ses Effets sur les Habitudes et les Mœurs. 8vo pamph. Porrentruy. 1853.

Échinides Nummutitiques. 8vo pamph. Porrentruy. 1853.

Natural History Society of Montreal.

Canadian Naturalist and Geologist, and Proceedings of the Natural History Society of Montreal. Vol. II. Nos. 2–6. Vol. III. No. 1. 8vo. Montreal. 1857–58.

G. M. Schultzy.

Theorie der Gegensältze oder Entwurf des Normalprinzips. 8vo. Königsberg. 1851.

K. K. Geologischen Reichsanstalt, Wien.

Jahrbuch. VII. Jahr. Nro 1, 2, und 3. 8vo. Wien. 1856.

Society of Arts, Manufactures, and Commerce.

Journal of the Society of Arts, and of the Institutions in Union. Vol. V. Nos. 215–245. 8vo. London. 1857.

Catalogue of the Ninth Exhibition of Inventions. Appendix I. to Vol. V. of Journal. 8vo. London. 1857.

Charles Francis Adams.

The Works of John Adams, Second President of the United States. With a Life of the Author, Notes, and Illustrations, by his Grandson, Charles Francis Adams. 10 vols. Royal 8vo. Boston. 1856.

Imperial Academy of Sciences, Vienna.

Sitzungsberichte. Math.-Natur. Classe. Band VI. Heft 1–4; Band XX. Heft 2 und 3; XXI. 1 und 2; XXII. 1, 2, und 3; XXIII. 1; Register Band XI.–XX. — Phil.-Hist. Classe. Band VI. Heft 1–5; XXI. 3; XXII. 1 und 2. — 8vo. Wien. 1851, 1856, 1857.

Denkschriften. Math.-Natur. Classe. Band XII. 4to. Wien. 1856.

Tafeln zu den Sitz. der Phil.-Hist. Classe. Band VI. Heft 1, 2, 3. (Archæologische Analecten von Joseph Arneth.) Folio. Wien. 1851.

Die Alterthümer vom Hallstätter Sabzberg und dessen Umgebung. Von Friedrich Simony. Als Beilage zu den Sitz. der Philos.-Histor. Classe der Kais. Akad der Wissenschaften. (Band IV. 1850. S. 338.) Folio. Wien. 1851.

Tageblatt der 32 Versammlung Deutscher Naturforscher und Arzte in Wien im Jahre 1856. No. 1–8. 4to. Wien. 1856.

Museum of Natural History in Paris.

Archives. Tome VIII. Livr. 3, 4. Tome IX. 4to. Paris. 1855–57.

American Antiquarian Society.

Proceedings in Boston, April 29, 1857; in Worcester, Oct. 21, 1857. 8vo. 2 pamphs. Boston. 1857.

Archæologia Americana. Transactions and Collections of the American Antiquarian Society. Vol. III. 8vo. Cambridge. 1850.

Academy of Natural Sciences, Philadelphia.

Proceedings. Vol. VIII. Nos. 3–5. Vol. IX. pp. 17–228. 8vo. Philadelphia. 1856–57.

Journal (N. S.). Vol. III. Pt. 4. 4to. Philadelphia. 1858.

Catalogue of Human Crania, in the Collection of the Academy of Natural Sciences of Philadelphia, based upon the 3d ed. of Dr. Morton's Catalogue of Skulls, &c. By J. Aitken Meigs, M. D. 8vo. Philadelphia. 1857.

American Association for the Advancement of Science.

Proceedings of the Tenth Meeting, held at Albany, New York, August, 1856; Eleventh, at Montreal, Canada East, August, 1857. 2 vols. 8vo. Cambridge. 1857–58.

W. C. Redfield.

On the Cyclones or Typhoons of the North Pacific Ocean; with a Chart showing their Courses of Progression. By W. C. Redfield. 8vo pamph. Philadelphia. 1856.

William J. Rhees.

An Account of the Smithsonian Institution, its Founder, Building, Operations, etc., prepared from the Reports of Prof. Henry to the Regents, and other Authentic Sources. 8vo pamph. Washington. 1857.

New York Historical Society.

Collections (2d Series). Vol. III. Part 1. 8vo. New York. 1857.

The Dutch at the North Pole and the Dutch in Maine. A Paper read before the New York Historical Society, 3d March, 1857. By J. Watts De Peyster, a Member of the Society. 8vo pamph. New York. 1857.

Observatory of Harvard College.

Annals of the Astronomical Observatory of Harvard College. Vol. II. Part 1. 4to. Cambridge. 1856.

British Government.

Memoirs of the Geological Survey of India. Vol. I. Part 1. With a Map. 8vo pamph. Calcutta. 1856.

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A. T. Kupffer.

Compte-Rendu Annuel, par le Directeur de l'Observatoire Physique Central, A. T. Kupffer. Année 1855. Suppl. 4to pamph. St. Petersbourg. 1856.

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A. Quetelet.

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Observations des Phénomènes Périodiques pour l'Année 1853. 4to pamph. Bruxelles. 1853.

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Samuel Kneeland, Jr., M. D.

Mémoires de l'Académie Royale de Chirurgie. 15 vols. 12mo. Paris. 1773 – 74.

A Dictionary of the Otchipwe Language, explained in English. .... By the Rev. Frederic Baraga. 1 vol. 16mo. Cincinnati. 1853.

Elements of Geometry, with Practical Applications, for the Use of Schools. By T. Walker. 1 vol. 12mo. Philadelphia. 1835.

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Bezout, and translated from the French by John Farrar. 1 vol. 8vo. Cambridge. 1824.

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A System of Arithmetic, reprinted from the Mathematical Text-Book compiled by the late President Webber, for the Use of the University at Cambridge. 1 vol. 8vo. Cambridge. 1812.

An Elementary Treatise on the Application of Trigonometry to Orthographic and Stereographic Projection, &c. By John Farrar. 1 vol. 8vo. Cambridge. 1822.

Catalogue of Pneumatic Instruments manufactured and sold by N. B. & D. Chamberlain; with Experiments illustrated by numerous Engravings and Notes. 1 vol. 8vo. Boston. 1844.

Denison Olmsted, LL. D.

Address on the Scientific Life and Labors of William C. Redfield, A. M., First President of the American Association for the Advancement of Science. Delivered before the Association at their Annual Meeting in Montreal, Aug. 14, 1857. 8vo pamph. New Haven. 1857.

Blinden Anstalt, Braunschweig.

Physiographie des Herzogthumes Braunschweig und des Karz-Gebirges, ... von Prof. W. Lachmann. Theil I. Névellement. Theil II. Geognosie. 8vo. Braunschweig. 1851 – 52.

Charles F. Chandler.

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David K. Tuttle.

Miscellaneous Chemical Researches. — Inaugural Dissertation addressed to the Philosophical Faculty of the Georgia Augusta University, Göttingen, on Promotion to the Degree of Doctor of Philosophy. 8vo pamph. Göttingen. 1857.

George C. Caldwell, B. S.

The Fatty Acids contained in the Oil of the Arachis Hypogæa and the Oleic Acid Series. — Inaugural Dissertation prepared for Promotion to the Degree of Doctor of Philosophy, and addressed to the Philosophical Faculty of the Georgia Augusta University at Göttingen. 8vo pamph. Göttingen. 1856.

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Dr. C. A. F. Peters.

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Zoölogical Society of London.

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Proceedings. Pt. XXIV. No. 305 to end of Volume. Pt. XXV. Nos. 327, 328. 8vo. London. 1856-57.

Nathan Appleton.

Remarks on Currency and Banking: having reference to the Present Derangement of the Circulating Medium in the United States. (3d ed.) With an Appendix. 8vo pamph. Boston. 1857.

Charles T. Beke, Ph. D., F. S. A., etc.

An Inquiry into M. Antoine d'Abbadie's Journey to Kaffa, in the Years 1843 and 1844, to discover the Source of the Nile. (2d ed.) 8vo pamph. London. 1851.

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Hon. Charles Sumner.

Report of the Commissioner of Patents for the Year 1856. — Agriculture. 1 vol. 8vo. Washington. 1856. [Pub. Doc.]

Maps and Views to accompany Message and Documents. 1856-57. 1 vol. 4to. Washington. 1857. [Pub. Doc.]

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Separatabdruck Naturwissenschaftlichen Abhandlungen aus den Schriften des Zoöl.-botan. Vereins in Wien. 1 vol. 8vo. Wien. 1856.

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Öfversigt af Kongl. Vetenskaps Akademiens Forhandlingar. — Trettonde Årgången 1856. 8vo. Stockholm. 1857.

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Report of the Twenty-sixth Meeting, held at Cheltenham, in August, 1856. 1 vol. 8vo. London. 1857.

Trustees of the Astor Library.

Catalogue or Alphabetical Index of the Astor Library. In Two Parts. Part I. Authors and Books. A – E and F – L. Roy. 8vo. New York. 1857 – 58.

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Professor Francesco Zantadeschi.

Ricerche sul Calorico Raggiante. 8vo pamph. Wien. 1857.

Boston Society of Natural History.

Journal. Vol. VI. No. 4. 8vo. Boston. 1857.

Franz Bopp.

Vergleichende Grammatik des Sanskrit, Send, Griechischen, Lateinischen, Littauischen, Altslavischen, Gothischen und Deutschen. Erster Band. Erste und Zweite Hälfte. 8vo. Berlin. 1856 – 57.

Albany Institute.

Description of New Organic Remains from Northeastern Kansas, indicating the Existence of Permian Rocks in that Territory. By F. B. Meek and F. V. Hayden, M. D. — Read before the meeting of March 2d, 1858. [Trans. Alb. Inst. IV.] 8vo. pp. 72 – 88. Albany. 1858.

Prof. Francis S. Holmes.

Remains of Domestic Animals discovered among Post-Pleiocene Fossils in South Carolina. — Also, Extracts from a Paper by Prof. Leidy of Philadelphia, and a Letter by Prof. Agassiz. 8vo pamph. Charleston. 1858.

Lyceum of Natural History of New York.

Annals. Vol. VI. No. 5, Oct. 1855; Nos. 6 and 7, Dec. 1856. 8vo. New York. 1855 – 56.

John Allan Broun, F. R. S.

Report on the Observations of His Highness the Rajah of Travancore at Trevandrum, and on the Agustier Peak of the Western Ghats. By John Allan Broun, F. R. S., Director of the Observatories. 8vo. Trevandrum. 1857.

T. Sterry Hunt.

Geological Survey of Canada. — Report of Progress for the Years 1853, '54, '55, '56. Printed by Order of the Legislative Assembly. 1 vol. 8vo. Toronto. 1857.

Plans of various Lakes and Rivers between Lake Huron and the River Ottawa, to accompany the Geological Reports for 1853, '54, '55, '56. 1 vol. 4to. Toronto. 1857.

G. J. Adler, A. M.

A Practical Grammar of the Latin Language, with Perpetual Exercises in Speaking and Writing. For the Use of Schools, Colleges, and Private Learners. 1 vol. 12mo. Boston. 1858.

G. C. Swallow.

The Rocks of Kansas. By G. C. Swallow and F. Hawn. With Descriptions of New Permian Fossils, by G. C. Swallow. 8vo pamph. St. Louis, Mo. 1858.

Verein für Näturkunde im Herzogthum Nassau.

Jahrbucher. Herausgegeben von C. J. Kirschbaum. Eilftes Heft. 8vo. Wiesbaden. 1856.

Fr. Argelander.

Anzeige von einer auf der Königlichen Universitats-Sternwarte zu Bonn unternommenen Durchmusterung des Nördlichen Himmels als Grundlage neuer Himmelscharten. 8vo pamph. Bonn. 1856.

Four hundred and fifty-second meeting.

MAY 25, 1858. — ANNUAL MEETING.

The PRESIDENT in the chair.

The President, in behalf of the Council, reported that at the present time the Academy has upon its list

147 Resident Fellows,
78 Associate Fellows, and
74 Foreign Honorary Members,

and mentioned their actual distribution among the classes and sections. The foreign list, which, at the last anniversary, bore the full number allowed by the statutes, now exhibits one vacancy, caused by the death of the celebrated mathematician Cauchy.

Four Associate Fellows have died during the past year, viz.: —

Admiral Owen, of New Brunswick,
Robert Hare, of Philadelphia,
William C. Redfield, of New York,
Thomas Crawford, of Rome.

No Resident Fellows have died since the last anniversary.

There have been elected into the Academy during the past year

8 Resident Fellows, — 5 in Class I., 2 in Class II., and 1 in Class III.;

2 Associate Fellows, — one of them into Class II., the other into Class III.; and

3 Foreign Honorary Members, — one in each Class.

The Annual Report of the Committee on the Library was read, accepted, and ordered to be placed on file.

The Annual Report of the Committee on Publications was read, accepted, and ordered to be placed on file.

The Treasurer presented his Annual Report, with the approval of the Auditing Committee annexed, which was accepted, and ordered to be entered on the records of the Academy.

On motion of Professor Lovering, it was voted that the sum of one thousand dollars be appropriated for the publications of the Academy for the ensuing year.

On motion of Professor Treadwell, it was voted that the sum of one hundred and fifty dollars be placed at the disposal of the Committee on Meteorology, for the purchase of a safe for the use of the Academy. Also, that eleven hundred dollars be appropriated for general expenses, and seven hundred dollars for the purchase of books for the Library, during the ensuing year.

The following gentlemen were elected Fellows, viz.: —

Dr. Thomas Edwards Clark, in Class II. Section 3.
Dr. Horatio R. Storer, in Class II. Section 4.
Dr. Henry Bryant, in Class II. Section 3.

The annual election was held, and the following officers were chosen for the ensuing year:—

Jacob Bigelow, *President.*
Daniel Treadwell, *Vice-President.*
Asa Gray, *Corresponding Secretary.*
S. L. Abbot, *Recording Secretary.*
J. P. Cooke, *Librarian.*
Edward Wigglesworth, *Treasurer.*

Council.

J. I. Bowditch, Joseph Lovering, E. N. Horsford,	of Class I.
Louis Agassiz, Jeffries Wyman, J. B. S. Jackson,	of Class II.
James Walker, Henry W. Torrey, Robert C. Winthrop,	of Class III.

The Standing Committees, nominated by the President, were elected as follows:—

Rumford Committee.

Eben N. Horsford, Joseph Lovering,
Daniel Treadwell, Henry L. Eustis,
Morrill Wyman.

Committee of Publication.

Joseph Lovering, Jeffries Wyman,
Cornelius C. Felton.

Committee on the Library.

A. A. Gould, W. B. Rogers,
George P. Bond.

Committee to Audit Treasurer's Accounts.

Thomas T. Bouvé, C. E. Ware.

Professor Cooke referred to his law of Classification in Chemistry, based on Homologism, published in the Academy's Proceedings, and stated the fact that his system had been adopted by Dumas, and offered to the world without proper credit to the author.

Four hundred and fifty-third meeting.

August 12, 1858. — Stated Meeting.

The President in the chair.

The Corresponding Secretary read letters from the Director of the Observatoire Physique Central, St. Petersburg, July 21, 1857; Königlich Sächsische Gesenschaft der Wissenschaften, October 1, 1857; Director der Sternwarte, Breslau, January 5, 1858; Director der Sternwarte, Prag, January 6, 1858; Linnæan Society, London, January 8, 1858; and the Société Royale des Antiquaires du Nord, Copenhagen, January 30, 1857, and March 27, 1858, acknowledging the receipt of the Academy's publications; — from the Königlich Bayerische Akademie der Wissenschaften, Munich, December 12, 1857, acknowledging the same, asking that deficiencies may be made up, and presenting various publications; — from the Königlich Preussische Akademie der Wissenschaften, October 24, 1857, presenting its publications, and acknowledging the receipt of those of the Academy; — from the Société Linnéenne de Lyon, July 21, 1854; Administration Imperiale des Mines, St. Petersburg, May 15, 1857; Société Imperiale des Naturalistes de Moscou, July 1, 1857; Königlich Sächsische Gesenschaft der Wissenschaften, Leipzig, October 1, 1857; and the Kaiserlich-Königliche Geologische Reichsanstalt, Wien, May 20, 1857, presenting their various publications; — and from the last, acknowledging the receipt of the Academy's publications, June 27, 1857. Also from T. Edwards Clark, May 27, accepting the Fellowship of the Academy; from Dr. William Sharswood, Philadelphia, June 17, accompanying a sealed parcel, indorsed "An Account of a Discovery in Chemistry," desiring that it might be deposited with the Academy until he should give directions for the seal to be broken; also from the same, under date of August 5, a letter presenting a copy of "Lindermanni Corpus Grammaticorum Latinorum," in four volumes, and suggesting an exchange of publications on the part of the Academy with the Entomologischer Verein zu Stettin, in accordance with the desire of that institution.

The Corresponding Secretary also read the following communication from Dr. William Sharswood, entitled "An Extract concerning the Antidote for Arsenious Acid."

"It is well known that to administer the acknowledged antidote for arsenious acid, that of hydrated oxide of iron, there are attending two difficulties; the first, that it is only in the recently precipitated condition that the above antidote is most active; secondly, that to form the above antidote at the time when required would, from the necessarily long time spent in its preparation, endanger the life of the patient. In answer to the two mentioned difficulties, I would offer the following new antidote, or, more properly, modification of the above antidote, in an isolated form. To prepare this, we have merely to take a solution of the proto-sulphate of iron, and, after having oxidized the iron by means of a few drops of nitric acid, precipitate the oxide with caustic magnesia, when the result is a precipitate of hydrated sesquioxide of iron, combined with sulphate of magnesia.

"It will be easily perceived, that, while this depends upon the same principles (excepting the desired effect produced by the presence of the sulphate of magnesia), it is at the same time characterized by facility and speed of preparation, which render it capable of being prepared on the moment, and thereby affording the desired state before alluded to, that of a recently precipitated condition."

A communication was next read from Professor J. P. Espy, concerning his theory of Storms, and presenting his work on the subject. Professor Espy's letter and book were referred to the Rumford Committee.

The President read a note addressed to him by Professor Benjamin Peirce, accompanying a letter from Dr. I. I. Hayes addressed to the Academy, and asking its good offices in the furtherance of the project of a new expedition, under his direction, to the Arctic regions. The following is the letter of Dr. Hayes: —

"PHILADELPHIA, July 19th, 1858.

"To DR. JACOB BIGELOW, LL. D., *President of the American Academy of Arts and Sciences.*

"SIR: —

"I purpose to attempt to reach the North Pole of the earth.

"To co-operate with me in relation to this object, the American Association for the Advancement of Science, at its last meeting, appointed a committee, consisting of Professor A. W. Bache, Professor Joseph Henry, Professor William B. Rogers, Professor Edward Hitchcock, Professor Benjamin Peirce, Professor J. D. Dana, Professor Joseph Winlock, Hon. Thomas Ewing, Hon. D. M. Barringer, Dr. John L. LeConte, Mr. J. E. Hilgard, Mr. Peter Force, Professor Joseph Leidy, Professor John Torrey, Professor S. S. Haldeman, and Professor Alexis Caswell.

"The American Philosophical Society, and the Academy of Natural Sciences of Philadelphia, have, with the same object, appointed committees.

"Desirous of having the counsel and favorable influence of the eminent association which you represent, I beg to submit my purpose to their consideration, and to say, that I shall gladly receive any suggestions which they may be pleased to make for the furtherance of science, or the special interests of the proposed expedition.

"I am, sir, with great respect,

"Your obedient servant,

"ISAAC I. HAYES."

Voted, that the letter of Dr. Hayes be referred to a committee of three; and the Chair nominated Professors Lovering, Winlock, and Eustis as the committee.

The subject of the Submarine Telegraph Cable between Europe and America having been introduced, Dr. Channing spoke at some length of the various causes which seemed to him likely to interfere with the ready transmission by it of the electric current. His remarks led to a desultory conversation on the best method of constructing an efficient and durable electric cable, in which Professor Treadwell, Dr. C. T. Jackson, Charles Jackson, Jr., Dr. H. R. Storer, Frank Storer, and the Recording Secretary, took part.

Professor Gray read the following "Note on the Coiling of Tendrils."

"As much as twenty years ago, Mohl suggested that the coiling of tendrils 'resulted from an *irritability* excited by contact.' In 1850 he remarked that this view has had no particular approval to boast of, yet that nothing better has been put in its place. And in another paragraph of his admirable little treatise on the Vegetable Cell (contributed to Wagner's *Cyclopædia of Physiology*), he briefly says: 'In my opinion, a dull irritability exists in the stems of twining plants and in tendrils.' In other words, he suggests that the phenomenon is of the same nature, and owns the same cause (whatever that may be) as the closing of the leaves of the Sensitive-plant at the touch, and a variety of similar movements observed in plants. The object of this note is to remark that the correctness of this view may be readily demonstrated.

"For the tendrils in several common plants will coil up more or less promptly after being touched, or brought with a slight force into contact with a foreign body, and in some plants the movement of coiling is rapid enough to be directly seen by the eye; indeed, is considerably quicker than is needful for being visible. And, to complete the parallel, as the leaves of the Sensitive-plant, and the like, after closing by irritation, resume after a while their ordinary expanded position, so the tendrils in two species of the *Cucurbitaceæ*, or Squash family, experimented upon, after coiling in consequence of a touch, will uncoil into a straight position in the course of an hour; then they will coil up at a second touch, often more quickly than before; and this may be repeated three or four times in the course of six or seven hours.

"My cursory observations have been principally made upon the Bur-Cucumber (*Sicyos angulatus*). To see the movement well, full-grown and outstretched tendrils, which have not reached any support, should be selected, and a warm day; 77° Fahr. is high enough.

"A tendril which was straight, except a slight hook at the tip, on being gently touched once or twice with a piece of wood on the upper side, coiled at the end into $2\frac{1}{2}-3$ turns within a minute and a half. The motion began after an interval of several seconds, and fully half of the coiling was quick enough to be very distinctly seen. After a little more than an hour had elapsed, it was found to be straight again. The contact was repeated, timing the result by the second-hand of a watch. The coiling began within four seconds, and made one circle and a quarter in about four seconds.

"It had straightened again in an hour and five minutes (perhaps sooner, but it was then observed); and it coiled the third time on being touched rather firmly, but not so quickly as before, viz. $1\frac{1}{4}$ turns in half a minute.

"I have indications of the same movement in the tendrils of the Grape-vine; but a favorable day has not occurred for the experiment since my attention was accidentally directed to the subject.

"I have reason to think that the movement is caused by a contraction of the cells on the concave side of the coil, but I have not had an opportunity for making a decisive experiment."

Professor Gray read a paper upon a new genus of plants of the Order *Rosaceæ*, recently discovered in Alabama, near Tuscaloosa, by the Rev. R. D. Nevius. The discoverer had proposed to dedicate the genus to the memory of the late Professor Tuomey, of Alabama, — an appropriate tribute to one who was so assiduously and successfully developing the natural history as well as the geology of his adopted State. But in this it now appears that Mr. Nevius has been anticipated by Dr. Harvey, who, in the third part of his *Nereis Boreali-Americani*, just published, has dedicated a new genus of fresh-water *Algæ* to Professor Tuomey. Professor Gray therefore proposes to name the present plant in honor of its discoverer, *Neviusia*, deriving the specific name from the State in which alone the plant is known to grow.

Neviusia Alabamensis is a shrub, with somewhat the habit of *Kerria Japonica*. In structure, likewise, it approaches *Kerria*, and also *Stephanandra*. It is especially interesting to botanists; first, because its nearest allies are all found in Japan, — adding another to the numerous links of connection between the Flora of our own country and that of Japan (a matter which Professor Gray proposes to illustrate upon another occasion); and, secondly, because it so connects the characters of *Kerria* and *Rhodotypos* with *Stephanandra* and *Neillia* as to show that they must all be referred to the same order and group. The new genus has a small quantity of albumen in the seed, but less than *Stephanandra;* its sepals are foliaceous and incised, more so than those of *Rhodotypos;* and it differs from all its allies in being apetalous. The full characters will be published in a memoir upon the genus.

Four hundred and fifty-fourth meeting.

September 14, 1858. — MONTHLY MEETING.

Professor FELTON in the chair.

Dr. A. A. Gould communicated some general scientific intelligence collected during his recent tour in Europe.

Colonel Samuel Swett read a paper containing an account of Colonel Mason's studies in electricity in the last century.

Mr. George P. Bond gave an account of Donati's Comet, and of the observations made upon it at the Cambridge Observatory up to the present time.

Dr. C. T. Jackson made some statements respecting the invention of the magnetic telegraph, and alleged that he himself first made known to Mr. Morse the general idea of the invention, and of the principles upon which it depended.

Mr. Swett presented his views upon the protection of houses from lightning, and argued that the wet exterior of a closed house, during a thunder-storm, was an efficient protection to the interior.

Mr. George S. Boutwell gave a detailed account of the phenomena of a very severe thunder-storm to which he was exposed in the year 1855.

Four hundred and fifty-fifth meeting.

October 12, 1858. — MONTHLY MEETING.

The PRESIDENT in the chair.

Professor Lovering made the following communication on Donati's Comet: —

"The polarization of light may be defined as a change in the ray, which is not the same as change of *direction*, but which is produced whenever a ray changes its direction by reflection, or refraction, or double refraction; in consequence of which change the susceptibility of the ray to a second reflection or refraction is altered. The first reflector or refractor, by which the change is produced, is called the *polarizer;* and the second reflector or refractor, by which the change is tested, is called the *analyzer.*

"To test polarized light is, therefore, to settle the question, whether the light under consideration has been already once before reflected or refracted. In this way, the polarization of light has been or may be used to discover whether the light of comets, of the rainbow, of halos, of coronæ, of sheet-lightning (or summer lightning), of the aurora, or the zodiacal light, is reflected, as that of the planets and satellites is reflected; or whether it is self-generated on the spot.

"What I have further to say relates to the polarization of the light of comets.

"Arago undertook, in 1811, to apply to the remarkable comet of that year the no less remarkable discovery of Malus in regard to the polarization of light. Arago used the doubly refracting analyzer, and expected to discover whether or not there were sensible traces of polarization in the light of the comet, by observing whether the relative brilliancy of the two images, produced by double refraction, changed when the analyzer was revolved. He decided in the affirmative, though he felt, as he admits, less confidence in his decision, on account of the uncertainty which always adheres to comparisons of relative brightness by the eye simply. The comet of 1819 afforded another opportunity of repeating the experiment. Still Arago was not so confident in the accuracy of his results as not to desire a third trial, and in a novel way, on Halley's comet, at its last return in 1835. On this latter occasion, Arago used a polarizer in which a doubly refracting prism is combined with a thin plate of quartz, and the two images are colored with complementary tints when polarized light is transmitted. More delicate traces of polarization, he thought, would show themselves by difference of contrasted tints in this polariscope, than by the corresponding changes of brightness in the old instrument. This last attempt left no doubt in Arago's mind that the light of the comets was polarized, and consequently that the comets shone principally by reflected light, coming of course from the sun. This conclusion does not exclude the possibility of other light mixed up with the polarized light, though itself unpolarized, and which is generated on the spot by changes which take place in the comet, making it to a certain extent self-luminous. The great comet of 1843, the next comer bright enough to allow of an examination into the nature of its light, was too brief a visitor, and too unfavorably situated when seen, to allow of any such observations, at least upon its nucleus. But the brilliant comet of 1858, which now distinguishes by its presence the northern sky, has lingered so long in view as to invite a renewed study into the origin of cometary light. By the invitation of Mr. G. P. Bond, I have twice visited the Observatory of Harvard College, and examined the light of this brilliant comet, when condensed in the focus of the great equatorial refractor. On the first of these occasions a Nicol's prism was used, and the changes in the brightness of the image corresponding to the rotation of the analyzer were very decided; and the positions of maxima and minima were indicated with complete unanimity in many independent experiments by Mr. Bond and myself. These experiments were made in such a way as to guard against self-delusion, — the experimenter not being able to see the position of his analyzer while he was judging of its positions of maxima and minima transmission of the light. On the second occasion, Savart's polariscope was used, in which plates of quartz and tourmaline are so combined as, with polarized light, to give colored fringes. The first glance through the polariscope at the light of the comet, condensed in the focus of the telescope, showed the field of view traversed by colored fringes, and betrayed strong traces of polarization in the light of this comet. If it is permitted to generalize from the few comets, on which experiments have been made, to comets in general, there can be no doubt that the comets, notwithstanding the almost universal absence of phase, are indebted to the sun for most, if not for all, of their light."

Dr. J. B. S. Jackson exhibited some specimens of the so-called Rocky Mountain Corn, in which each kernel has its own investing husk; this he had raised himself, and he noticed that some ears of common naked corn grew from the same seed. This has been supposed to be the original state of Indian Corn.

Professor Gray remarked that there is no evidence, and no probability, that maize is indigenous to the Rocky Mountains, or anywhere so far north, but that it is a tropical production. He had once supposed that this form might be the original state of Corn, but he was now convinced that it was an induced or monstrous form, with a tendency to become proliferous or paniculate, instead of producing simple spikes.

Professor C. C. Felton communicated to the Academy an extended memoir by Mr. Sophocles, of Harvard University, entitled, "A Glossary of Later and Byzantine Greek."

He also gave some particulars of his recent visit to Greece, in the summer season. As to the climate, the thermometer in June did not rise above 75° F., except for two or three days toward the end of the month, when it indicated 83° and 84°, which was the highest he noticed. He had observed a remarkable progress since his first visit in 1853–54, in spite of the occupation of the country by foreign armies and the prevalence of cholera, in industrial pursuits, art, literature, and especially in education, not only in Greece proper, but wherever the Hellenic race was found in Turkey and Asia Minor.

Four hundred and fifty-sixth meeting.

November 10, 1858. — STATED MEETING.

The VICE-PRESIDENT in the chair.

The Corresponding Secretary read letters from the Royal Academy of Sciences of Madrid, and the Natural History Society of Freiburg in the Briesgau. Also a letter from William Sharswood, Esq., of Philadelphia, in relation to the probable action of phosphoric acid upon non-acid calculi in the bladder.

Professor Joseph Lovering, in behalf of the committee to whom was referred the communication of Dr. I. I. Hayes, dated July 19, 1858, requesting "the counsel and the favorable influence of the Academy" in his proposed attempt to reach the north pole of the earth, read the following report: —

"The announcement of an open sea within the Arctic Ocean was made in these words by Dr. Kane, after the return of his man Morton from a sledge excursion in June, 1854: 'It must have been an imposing sight, as he stood at this termination of his journey, looking out upon the great waste of waters before him. "Not a speck of ice," to use his own words, "could be seen." There, from a height of four hundred and eighty feet, which commanded a horizon of almost forty miles, his ears were gladdened by the novel music of dashing waves; and a surf, breaking in among the rocks at his feet, stayed his further progress.' *

"The committee have quoted the eloquent language of Dr. Kane, without stopping to inquire how much of this glowing description is to be referred to the enthusiasm of an explorer, and how much is to be interpreted by a cool criticism at a distance from the scene of operations.

"The question which it is expected may be settled by another Arctic expedition is, whether the great ice-barrier, which, on some meridians, and at some seasons, encroaches even upon the 48th parallel of latitude, and which invests an area of six millions of square miles, extends northwards to the pole; or whether, beyond the limits of extreme Arctic navigation, which leaves an unexplored surface of three millions of square miles, there lies imprisoned in a zone of ice the unfrozen waters of a polar sea. The conclusion of Dr. Kane, that the latter was the true side of the alternative, was anticipated by that of a Russian expedition on sledges in 1810, made upon an opposite meridian to that which Kane travelled, and by that of Parry in 1827, upon a third meridian.

"The impression favorable to an open and navigable polar sea, which was obtained on these occasions, based as it was upon a very circumscribed experience, and prevented by stress of circumstances from being pursued to verification, might seem to fall considerably short of a rational belief, were it not, in the opinion of Dr. Hayes and others, corroborated by various kinds of circumstantial evidence, as follows: —

"1. By the presence of bird life, mostly marine, on what would be the icy shores of this suspected sea, and which migrates northward in spring.

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* Arctic Explorations in the Years 1853-54-55, by Dr. Elisha K. Kane, Vol. I. p. 305.

"2. By the milder temperature at extreme latitudes inferred from the character of the isothermals where best determined, which, pursued by analogy to unvisited latitudes, give the same temperature to the high latitude of 90° as to the Arctic Circle.

"3. By the migrations of human life, the traditions of the Esquimaux pointing to the North as the cradle of their race. If the fact is established that races deteriorate as they remove from the parallel of their nativity, then the tradition of the degenerate Esquimaux is confirmed by their own degeneracy.

"4. By the temperature of the Arctic waters, which was observed by William Morton and recorded by Kane as at 36° Fahr. in June, 1854, or two degrees above the temperature of the air at the same time; the water flowing from the north, and no ice in sight. Whether this water is frozen in winter is not, however, known.

"5. By the rise of the temperature in winter when the north-wind sets in, which is also damp; as observed by Baron von Wrangel and Sir Edward Parry. The cause of this elevated temperature in the Arctic waters, Dr. Hayes thinks, may be found in the influence of the Gulf Stream, flowing northward as an under-current to equalize the effects of the superficial flow southward. This direction in the flow of the deep water is inferred from the drift of the deeply-laden icebergs northward, while the lighter ones move southward. Moreover, what compensation for astronomical exposure may not the drainage of five millions of square miles from the northern water-sheds of Europe, Asia, and America introduce into the temperature of the great Arctic basin?

"If these mild waters, embosomed for centuries in a zone of ice, are to be reached by civilized man, Dr. Hayes thinks that the best invitation to success comes, not from a purely nautical expedition along the easterly coast of Greenland, but from more westerly meridians, to be traversed by boats and sledges.

"The committee do not feel called upon to examine singly or collectively the force of these various arguments in favor of an open polar sea. It is certain, however, that human curiosity will not be satisfied until the mystery on this subject is cleared up by new expeditions. To postpone these expeditions to another generation, when much of the personal experience already gained will have been forgotten, and when the services of those best qualified to conduct them can no longer be commanded, would not be a wise economy.

"With these few hints on the views and objects of Dr. Hayes in his appeal to the Academy for scientific aid and sympathy, your committee conclude with the recommendation of the following resolutions:—

"*Resolved*, That the American Academy of Arts and Sciences appreciate highly the laudable ambition of Dr. I. I. Hayes, to continue, and if possible consummate, the arduous exploration for which he has already sacrificed much, and is willing to sacrifice still more; and that the Academy tender him their sympathy and influence.

"*Resolved*, That a committee of seven be appointed, from the members of the Academy, to co-operate with Dr. Hayes, and to render him such scientific counsel as may make his new effort, if undertaken, secure the greatest advantages to science and humanity.

"JOSEPH LOVERING,
HENRY L. EUSTIS,
JOSEPH WINLOCK, } *Committee.*"

On motion of Professor Felton, the resolutions were adopted unanimously; and the subject was again referred to a committee, consisting of Professor Joseph Lovering, Professor Henry L. Eustis, Professor Joseph Winlock, Thomas G. Cary, Esq., B. A. Gould, Esq., Professor Theophilus Parsons, and Edward Wigglesworth, Esq.

Professor H. L. Eustis gave an account of Barlow's new method of calculating the strength of girders.

Professor C. C. Felton exhibited a collection of rare Roman coins which he had recently received.

Professor E. N. Horsford exhibited the Tyrian dye, or murexide in a crystalline form, and explained the new mode of obtaining it.

On motion of Professor Lovering, one hundred dollars was added to the appropriation for publication during the current year, to replace a sum which had been paid out from that appropriation by a vote of the Academy at the stated meeting in August last.

The following gentlemen were elected Fellows of the Academy:—

Dr. Luther V. Bell, of Charlestown, in Class II. Section 4.

Rev. Dr. Chandler Robbins, of Boston, in Class III. Section 2.

Professor Benjamin Peirce, of Cambridge, in Class I. Section 1.

Four hundred and fifty-seventh meeting.

December 14, 1858. — Monthly Meeting.

The Academy met at the house of Chief Justice Shaw.

The President in the chair.

The Corresponding Secretary read letters from the Rev. Chandler Robbins and Dr. Luther V. Bell, accepting their election as Fellows of the Academy.

Also from the K. L. C. Akademie der Naturforscher, Breslau, November 20th, 1857, and January 20th, 1858; Académie Royale des Sciences à Amsterdam, December 10th, 1857; K. Sächs. Bergakademie, Freiburg, December 13th, 1857; Royal Geographical Society, London, December 30th, 1857; Observatoire Physique Centrale, St. Petersburg, June 1st, 1858; Royal Society of Sciences of Upsal, January 8th, 1858; K. Sächs. Gesellschaft der Wissenschaften, January 6th, 1858; Naturhistorischer Verein der Preussischen Rheinlande und Westphalens, January 11th, 1858; Société Imperiale des Naturalistes de Moscow, March 10th, 1858; Académie Royale des Sciences, Turin, May 15th, 1858; and the Royal Society of Sciences, Göttingen, May 26th, 1858, acknowledging the receipt of the Academy's publications; — from the Gesellschaft zur Beförderung der Naturwissenschaften zu Freiburg im Breisgau, June 25th, 1858, acknowledging the same, and presenting its own publications; — from the Oberhessische Gesellschaft für Natur- und Heilkunde, April 6th, 1858, and the Société Imperiale d'Agriculture, &c., August 8th, 1858, presenting their publications; — from the Société d'Agriculture, Sciences, et Arts de la Sarthe, March 30th, 1858, presenting various publications and asking an exchange; — and from M. de Haar, of Holland, presenting a mathematical memoir, and asking a critical opinion of its merits.

On motion of Professor D. Treadwell, the memoir of M. de Haar was referred to a committee, consisting of Professor B. Peirce, Professor Joseph Winlock, and Rev. Thomas Hill.

Professor Agassiz addressed the Academy on the subject of the Classification of Fishes. He spoke of the unsatisfactory character of the systems of different naturalists, growing out of a want of some common fundamental feature, corresponding to their greater or less complexity of structure, which should serve as a basis. In regarding the whole series of Vertebrata, Professor Agassiz has been led to consider the structure of the mouth as related to the facial bones in their greater or less development and complexity, as furnishing a hint for the classification of this department of the animal kingdom. Fishes differ widely in the structure of the mouth, and by a careful analysis of this structure he had been led to a general deduction, that those fishes in which there is the fullest development of the facial bones should be placed at the head of the series, as coming nearest to the highest Vertebrata, while those at the opposite extreme should be placed last. Arranged by this test, the Ganoids would hold the first rank, and the Myzontes the last; and so with the intermediate families. And he thought that his view would be sustained by a fuller investigation of all the anatomical characters of the class; the greater or less complication and development of their structure in general being found to conform to the structure of the face and mouth. Professor Agassiz illustrated his view by a comparison of the anatomical structure of these parts, as well as other parts, in the Siluroids, the Loricarians, Sturgeons, Salmon, Sharks, &c.

Professor Peirce made a communication on the law of the formation of the tails of comets, explaining his own special views on the subject. He also presented, in behalf of Professor Winlock, a comparison between the American and British Ephemeris of the Moon for 1856, showing much greater accuracy in the American Ephemeris.

Professor Peirce also presented the results of the working of the Calculating Machine at the Dudley Observatory, for the Nautical Almanac. The computations had been made with reference to the tables of Mars. He also exhibited the lead plates stamped by the machine, and explained its working.

Dr. H. R. Storer read a paper, tending to show the rapid diminution of the rate of increase in the number of births in Europe and America, especially in Massachusetts. It was remarked, that certain generally admitted facts had hitherto been a problem to political economists. By a comparison of extensive statistical tables Dr. Storer indicated the direct dependence of this decrease, apparently, upon criminal causes. The question would be elsewhere more fully and thoroughly discussed. It was evident from a consideration of the data, that the state of the case as respects Massachusetts was not exceptional, but was merely here brought to light by means of our more careful registration.

Professor Parsons stated that a memorial would be presented to the Legislature of Massachusetts during the coming session, asking for aid in publishing a new edition of the late Dr. Harris's valuable work on Insects injurious to Vegetation, and that it is desirable that the Academy should add its influence to that of the Societies with which it originated. On his motion it was voted, that the President be authorized to sign the memorial in behalf of the Academy.

Professor Gray communicated three papers upon the Botany of the United States North Pacific Exploring Expedition under Captain John Rodgers (succeeding Captain Ringgold), by permission of the commander of the Expedition, viz.: —

1. An Account of the new Phænogamous Plants collected by Charles Wright, the Botanist of the Expedition; with a notice of the Vegetation of Japan in its relations to that of the Northern Temperate Zone generally. [Published in the Memoirs of the Academy.]

2. *Characters of some New Filices, from Japan and Adjacent Regions, collected by Charles Wright in the North Pacific Exploring Expedition under Captain John Rodgers.* Communicated by permission of the Commander of the Expedition, by Daniel C. Eaton.

1. Adiantum monochlamys: gracile; stipite rhachique ebeneo nitido; fronde ovato-lanceolata tripinnata; pinnulis chartaceis glaberrimis longe pedicellatis anguste cuneatis obcordatis indivisis siccitate striatis margine revolutis apice acute serratis in sinu monosoriferis; involucro orbiculari submembranaceo.

Hill-sides near Simoda, Japan.

2. Athyrium cystopteroides: caudice repente tenui vix paleaceo; frondibus erectis stipiti gracili impositis membranaceis lanceolatis pinnatis; pinnis ovato-lanceolatis acutis pinnatipartitis, segmentis (basilaribus nunc liberis) ovatis obtusis dentatis crenatisve supra glabris subtus parce glandulosis, venis utrinque pubescentibus pinnatis, venulis simplicibus vel furcatis; indusio hispido margine glandulifero, nunc oblongo lateri adfixo, nunc reniformi-orbiculari venulæ insidente.

Var. β. elatius; pinnis lanceolatis pinnatisectis, segmentis oblongis obtusis integris; venulis simplicibus; indusio minus hispido.

Ousima, Katonasima, and Anakerima, Loo Choo Islands.

3. Lastrea lacera (Polypodium lacerum, *Thunb. Fl. Jap. p.* 337!): frondibus e caudice brevi crasso pluribus stipite breviori valde paleaceo insidentibus subcoriaceis glabris subtus albicantibus oblongis acutis bipinnatis; pinnis late-lanceolatis acuminatis pinnatis vel pinnatifidis, intermediis longioribus, superioribus contractis fructiferis; segmentis oblongis vel falcatis acutis serratis, basilaribus nunc utrinque subauriculatis; soris confertis demum confluentibus; indusio orbiculari usque ad medium fisso, sinu clauso lateribus inflexis.

Simoda, Japan.

4. Woodsia (Hymenocystis) polystichoides: cæspitosum, glabriusculum; stipite brevi sparsim paleaceo; frondibus erectis elongato-lanceolatis pinnatis; pinnis subcoriaceis confertis lineari-oblongis subfalcatis obtusis auricula majuscula e basi superiori semi-hastatis fere integerrimis, inferioribus sensim minoribus deflexis; venis pinnatis, venulis furcatis; soris apice venulæ superioris impositis prope mar-

ginem seriatis; indusio subgloboso cystiformi 4–6-fido, lobis imbricatis; receptaculo oblongo.

On hill-sides near Hakodadi, Japan.

5. TRICHOMANES LATEMARGINALE: pusillum; caudice repente filiformi tomentoso; frondibus subsessilibus 3–6 lineis longis pellucidis glabris nunc palmato 3–6-partitis nunc pinnatifidis, laciniis lineari-oblongis integerrimis obtusis nervilla intra duplicem seriem cellularum marginalium cinctis; involucro omnino immerso infundibuliformi breviter bilabiato; receptaculo longe exserto; areolatione hexagonali conspicua fragmentis venularum conspersa.

Creeping on rocks in mountain ravines, near Hong Kong, China.

3. *Characters of New Fungi, collected in the North Pacific Exploring Expedition by Charles Wright.* (Communicated by request of Captain Rodgers.) By REV. M. J. BERKELEY, M. A., F. L. S., &c., and REV. M. A. CURTIS, Associate Fellow of the Academy.

1. AGARICUS (LEPIOTA) AUCTUS, Berk. & Curt.: pileo hemisphærico carnoso albo in squamulas granulosas fuscas rupto, margine e velo appendiculato; stipite elongato æquali; lamellis latiusculis remotis.

On sides of hills, Hong Kong, Aug. 1854.

2. A. (LEPIOTA) DEPRAVATUS, Berk. & Curt.: pileo convexo stipiteque subæquali furfuraceo-verrucosis ex albo brunneis; lamellis ventricosis postice emarginatis adnexis.

In woods among leaves, Bonin Islands. — Has some resemblance to *A. acute-squamosus*, Weinm.

3. A. (LEPIOTA) HEMISOÖDES, Berk. & Curt.: albus, pileo campanulato epidermide continua esquamulosa; stipite basi subbulboso gracili; lamellis angustis remotis postice distinctis.

On decayed wood, Bonin Islands. — Resembles *A. continuus* of Ceylon, but is smaller and with the gills not reticulated behind.

4. A. (ARMILLARIA) TYMPANITICUS, Berk. & Curt.: cæspitosus; pileo convexo rufo-brunneo; stipite deorsum attenuato sursum ventricoso albo-brunneo; annulo membranaceo; lamellis concoloribus angustis.

On dead wood, Bonin Islands. — Allied to *A. mucidus*.

5. A. (TRICHOLÓMA) PERIPORPHYRUS, Berk. & Curt.: obscure

purpureus, cæspitosus, pusillus; pileo e convexo plano glabrato; stipite gracili; lamellis crassis adnatis.

Shady hill-sides, Bonin Islands. — Allied to *A. onychinus.*

6. A. (Collybia) talpinus, Berk. & Curt.: flavidus; pileo tenui stipiteque basi strigoso-radiato subtiliter velutinis; lamellis angustissimis adnexis.

On decayed wood, Bonin Islands. — Allied to *A. velutipes.*

7. A. (Collybia) palmicola, Berk. & Curt.: pusillus; pileo convexo glabro aurantiaco margine inflexo; stipite subconcolore glabro basi radiato-strigoso; lamellis adnexis crassiusculis pallidioribus.

On dead Palms, &c., Bonin Islands.

8. A. (Collybia) efflorescens, Berk. & Curt.: flavidus; pileo planiusculo stipiteque sursum dilatato subtiliter pulverulento-velutinis; lamellis liberis modice latis venoso-connexis.

On decayed wood, Bonin Islands. — Allied to *A. velutipes,* but far less velvety. We believe it is *Marasmius rufus* of Montagne.

9. A. (Collybia) poigenus, Berk. & Curt.: fuscus; pileo hemisphærico striato glabro; stipite insititio deorsum velutino; lamellis adnexis subdistantibus.

On dead grass, Hong Kong. — Has the habit of *A. stipitarius.*

10. A. (Collybia) adianticeps, Berk. & Curt.: flavidus; pileo demum depresso striato, margine crenato appendiculato; stipite cartilagineo æquali; lamellis angustis adnexis.

Hill-sides, Hakodadi, Japan. — The pileus of this pretty species looks very much like the frond of an *Adiantum,* from its long striæ, and crenate, appendiculate margin.

11. A. (Mycena) Californiensis, Berk. & Curt.: pileo ex conico breviter campanulato stipiteque gracili rufis; lamellis liberis albis rubro-marginatis.

On Oak leaves, Mare Island, California. — Differs from *A. aurantio-marginatus* in the nature of the gills, and is a more graceful species.

12. A. (Mycena) alphitophyllus, Berk. & Curt.: pileo leviter depresso molli succulento viscoso albo; stipite brevi rufescente; lamellis latiusculis distantibus adnexi-decurrentibus pulverulentis; sporis magnis globosis.

On decayed logs, Bonin Islands. — This may perhaps be the type of a distinct genus. The spores are very peculiar, as also the manner in which the gills separate below, reminding one of *Paxillus.*

13. A. (Mycena) dicranophyllus, Berk. & Curt.: pileo subdepresso hyalino sordide albo; stipite insititio glabro sursum dilatato; lamellis purpurascenti-albis furcatis ramosisque distantibus subtiliter pulverulentis; sporis minoribus globosis.

On dead sticks, Bonin Islands. — Closely resembles the preceding; but differs in the small spores, as well as in other particulars.

14. A. (Mycena) leucoconis, Berk. & Curt.: pileo umbrino leviter depresso viscoso; stipite robustiore deorsum incrassato medio tenuiore albo; lamellis latiusculis distantibus adnatis albis demum secedentibus albo-pulverulentis.

On wood, Bonin Islands. — Distinguished from the following by its thicker pileus and white spores.

15. A. (Mycena) rhodoconis, Berk. & Curt.: albus; pileo leviter depresso tenuissimo viscoso; stipite sursum incrassato basi dilatato; lamellis latiusculis distantibus adnatis roseo-pulverulentis.

On decayed wood, Bonin Islands.

16. A. (Mycena) cladophyllus, Berk. & Curt.: pileo hemisphærico membranaceo delicato striato albo; stipite gracili rufo; lamellis angustis distantibus ramosis.

On dead wood, Hong Kong. — Resembles a *Marasmius*.

17. A. (Mycena) hemileucus, Berk. & Curt.: pileo ex conico-campanulato expanso umbrino; stipite stricto lamellisque adnexis distantibus albis.

On decayed wood, Bonin Islands.

18. A. (Mycena) chætodes, Berk. & Curt.: pileo hemisphærico ex albo griseo striato; stipite elongato basi pilis longis strigoso; lamellis paucis subangustis adnexis.

Amongst leaves, &c., under trees, Hong Kong.

19. A. (Mycena) chlorophos, Berk. & Curt.: ex albo viriditinctus, lumen viride emittens; pileo depresso striato viscidulo; stipite pulverulento sursum dilatato e basi orbiculari oriundo; lamellis subdistantibus ventricosis leviter decurrentibus.

Dead logs, Bonin Islands. — Highly luminous at night.

20. A. (Mycena) cyanophos, Berk. & Curt.: albus, lumen cæruleum spargens; pileo hemisphærico campanulato viscidulo; stipite pulverulento sursum dilatato e basi orbiculari delicata pulverulento-tomentosa oriundo; lamellis liberis.

On decayed wood, Bonin Islands. — Closely allied to the last, but differing in its free gills, &c.

21. A. (MYCENA) PITYRODES, Berk. & Curt.: albus, tenerrimus; pileo campanulato furfuraceo; stipite gracili flocculento e basi orbiculari estriata oriundo.

On decayed wood, Bonin Islands. — Allied to *A. tenerrimus*, Berk.

22. A. (OMPHALIA) USTA, Berk. & Curt.: rufus; pileo tenui infundibuliformi glabro; stipite recto sursum incrassato basi orbiculari strigosa affixo; lamellis angustis decurrentibus.

On dead twigs, Bonin Islands. — Somewhat resembling *A. pyxidatus*.

23. A. (OMPHALIA) RUFICEPS, Berk. & Curt.: rufus; pileo depresso membranaceo; stipite glabro; lamellis angustis distantibus decurrentibus venoso-connexis.

On dead wood, Bonin Islands.

24. A. (OMPHALIA) EPHIPPIUM, Berk. & Curt.: purpureo-fuscus; pileo umbilicato subsquamuloso; stipite sursum dilatato nigro-punctato; lamellis crassiusculis decurrentibus.

On the ground, Bonin Islands. — Allied to *A. umbelliferus*. The helvelloid form of the pileus when dry is peculiar.

25. A. (OMPHALIA) OUSIMÆ, Berk. & Curt.: pileo pallide fusco striato depresso glutinoso; stipite gracili; lamellis distantibus decurrentibus tenuibus albis.

In the crevices of bark of trees, Ousima, north of the Loo Choo Islands. — Allied to *A. umbelliferus* and *stellatus*, but distinguished from the former by its thin gills and gelatinous pileus; and from *A. stellatus* by the latter character and by the base not being stellate.

26. A. (OMPHALIA) BEHRINGENSIS, Berk. & Curt.: pileo depresso cupulæformi glabro striato luteo-albo; stipite sursum incrassato; lamellis adnato-decurrentibus latiusculis distantibus albis.

Arakamtchetchene Island, Behring's Straits. — Approaches *Cantharellus Behringensis*, but the gills are not forked, &c.

27. A. (OMPHALIA) PORPHYROMIGES, Berk. & Curt.: pallide purpureus; pileo umbilicato tenui; stipite sursum incrassato basi discoidea affixo; lamellis distantibus angustis decurrentibus.

On decayed wood, Bonin Islands.

28. A. (OMPHALIA) PLUMBARIUS, Berk. & Curt.: pileo convexo centro depresso griseo-plumbeo; stipite recto basi floccis brevibus affixo; lamellis distantibus decurrentibus.

On rotten sticks, in the Bonin Islands.

29. A. (PLEUROTUS) CONNATUS, Berk. & Curt.: pallide luteus; pileis excentricis tenuibus nitentibus glabris; stipitibus fibrillosis connatis; lamellis decurrentibus; annulo deflexo.

Arakamtchetchene Island, Behring's Straits; on decayed wood.—This has the habit and colors of *A. pudicus;* but the gills are decurrent, and the spores white.

30. A. (PLEUROTUS) PROMETHEUS, Berk. & Curt.: albus, phosphoreus; pileo tenui flabelliformi minutissime virgato-maculato in stipitem brevissimum postice attenuato; lamellis crebris angustis.

On dead wood, Hong Kong.—The most delicate of the phosphorescent Agarics.

31. A. (PLEUROTUS) ALOPECIUS, Berk. & Curt.: ex albo subfulvus; pileo excentrico subreniformi vel orbiculari glabro; stipite brevi sursum dilatato; lamellis ventricosis confertis adnexis.

On decayed logs, Bonin Islands.—A delicate and curious species.

32. A. (PLEUROTUS) LEIOPHYLLUS, Berk. & Curt.: albidus; pileo reniformi tenui; stipite brevissimo; lamellis angustis crassiusculis subdistantibus adnatis; interstitiis lævibus.

On dead sticks, Bonin Islands.

33. A. (PLEUROTUS) LIVIDULUS, Berk. & Curt.: resupinatus; pileo reniformi seu flabellato demum lobato purpurascenti-livido pulverulento-hispidulo glabrescente; stipite nullo; lamellis pileo concoloribus demum albis.

On dead twigs, Bonin Islands.—Allied to *A. spiculiferus*, Berk.

34. A. (PLEUROTUS) SQUAMULA, Berk. & Curt.: resupinatus, villo albo affixus, margine libero; strato superiore gelatinoso; pileo suborbiculari glabrescente lamellisque crassiusculis luteis; stipite nullo.

On decayed wood, Bonin Islands.—Allied to *A. spiculiferus*, Berk.; but the pileus is half attached, the stem wanting, &c.

35. A. (VOLVARIA) MICROSPILUS, Berk. & Curt.: pileo hemisphærico tenuissimo badio sericeo particulis obscurioribus virgato; stipite tenui e volva badia adnata emergente; lamellis latiusculis liberis.

On decayed wood, Bonin Islands.—An exquisite little species.

36. A. (PLUTEUS) ARENULOSUS, Berk. & Curt.: pileo convexo candido centro diffracto verruculoso margine striato; stipite tenui flexuoso brevi; lamellis ventricosis liberis remotis.

On dead wood, Bonin Islands.—Analogous to *A. cristatus*.

37. A. (Leptonia) virescens, Berk. & Curt.: totus pallide cyaneus, siccitate virescens; pileo centro depresso; lamellis latiusculis distantibus adnexis.

On the ground, Bonin Islands. — A very curious species. The gills stain the drying-paper with a yellow-olive tint.

38. A. (Eccilia) glauci-brunneus, Berk. & Curt.: pileo infundibuliformi tenui striato umbrino; stipite lamellisque decurrentibus glauco-albis.

Mountain-sides, Hong Kong.

39. A. (Hebeloma) venifer, Berk. & Curt.: pileo tenui striato glabro, margine reflexo albido; stipite æquali brunneolo; lamellis angustis liberis umbrinis; interstitiis eximie venosis.

Damp ground, Arakamtchetchene Island, Behring's Straits. — A beautiful species, allied to *A. rimosus*, but distinguished by its smooth pileus, reticulated interstices, reflected margin, &c.

40. A. (Flammula) holocirrhus, Berk. & Curt.: minor, fulvus; pileo sub lente floccis squamulisve innatis subtiliter notato quandoque glabro; stipite tenui fibrilloso-striato; lamellis flavo-punctatis decurrentibus; sporis minutissime echinulatis.

On dead wood, Bonin Islands. — Allied to *A. penetrans*, but smaller.

41. A. (Naucoria) stellulatus, Berk. & Curt.: pileo convexo tenui badio, sicco rufescente, verrucis pyramidatis basi sericeo-stellatis, centro aspero, margine squamuloso; lamellis adnexis ferrugineis.

On decayed wood, Japan. — Allied to A. *conspersus*.

42. A. (Naucoria) Nicotiana, Berk. & Curt.: pileo convexo diffracto-squamoso fusco; squamis squarrulosis, margine appendiculato; stipite sursum attenuato fibrilloso-squamoso subcæruleo; lamellis ventricosis arcuato-adnexis.

Damp hill-sides, Behring's Straits. — Allied to *A. conspersus* and *escharoides*.

43. A. (Galera) Japonicus, Berk. & Curt.: magnus; pileo conico-campanulato tenui spadiceo; stipite elato gracili fibrilloso basi incrassato; lamellis adscendentibus peroxydatis.

On dead wood, Hakodadi, Japan. — Allied to *A. Apalus*.

44. A. (Galera) liratus, Berk. & Curt.: pusillus; pileo umbilicato sulcato atomato rufo; stipite brevi; lamellis paucis latis adnatis.

On the bark of Oak-trees, Mare Island, San Francisco Bay, California. — Resembles a *Marasmius*, with the habit of *A. corticola*.

45. A. (CREPIDOTUS) PALMULARIS, Berk. & Curt.: pileo reniformi subrufo striato marginem versus transversim ruguloso; lamellis latis subconcoloribus.

On dead wood, Bonin Islands.

46. A. (CREPIDOTUS) UBER, Berk. & Curt.: pileo reniformi tenui ex albo luteo-fusco viscidulo; lamellis confertis ferruginosis e sporis luteis.

In shady woods, Bonin Islands. — Allied to *A. mollis* and *malachius*.

47. A. (CREPIDOTUS) LEUCOCHRYSOS, Berk. & Curt.: luteus; pileo subflabelliformi vel reniformi subtiliter tomentoso glabrescente; stipite nullo; lamellis distantibus.

On decayed wood, Bonin Islands.

48. A. (CREPIDOTUS) SCYMNODES, Berk. & Curt.: pileo dimidiato tenui ex albo leonino subtiliter villoso; villis innatis liberisque floccis affixis; lamellis confertis.

On dead Palm-leaves, Bonin Islands. — Closely allied to the last.

49. A. (CREPIDOTUS) HÆMATITES, Berk. & Curt.: atro-sanguineus; pileo reniformi postice affixo glabro; lamellis ventricosis latiusculis.

On dead wood, Hong Kong. — Has somewhat the habit of *Panus*.

50. A. (CREPIDOTUS) CACAO, Berk. & Curt.: brunneus; pileo suborbiculari glabro siccitate rugoso margine inflexo; lamellis latiusculis.

On dead wood, Bonin Islands.

51. A. (CREPIDOTUS) FLAVO-LIVENS, Berk. & Curt.: pileo flabelliformi flavido pulverulento; stipite nullo; lamellis angustis purpureo-albis.

On dead wood, Bonin Islands.

52. A. (PSALLIOTA) PRIMIPILUS, Berk. & Curt.: pileo amplissimo fortiter umbonato brunneolo squamis minutis sericeis brunneis ornato; stipite subbulboso; lamellis latis argillaceis.

Shady hill-sides, Bonin Islands. — Resembles some variety of *A. procerus*, but has colored spores; also like *A. cretaceus*, but with larger and differently-shaped spores.

53. A. (PSALLIOTA) ASOTUS, Berk. & Curt.: fasciculatus; pileo convexo fusco-purpureo; stipite elato solido concolore; mycelio expanso albo; lamellis latis adnatis.

Amongst Rice straw and rubbish, Hong Kong. — Allied to *A. semiglobatus*, but far larger.

54. A. (Psalliota) porphyrophyllus, Berk. & Curt.: pileo albo centro umbonato luteo viscoso nitido; stipite deorsum incrassato albo; lamellis ventricosis adnexis purpureis.

On the ground, Japan. — Closely allied to *A. semiglobatus.*

55. A. (Psathyra) fusco-niveus, Berk. & Curt.: pileo campanulato tenui pallide fusco areolis minutis veli reliquiis distincto; stipite niveo glabro; lamellis adnexis phæotis.

On hill-sides, Bonin Islands. — Resembles *A. spadiceo-griseus.*

56. Hiatula luteola, Berk. & Curt.: pallide flava; pileo hemisphærico striato hyalino; stipite glabro sursum incrassato; lamellis liberis angustis subdistantibus remotis.

On dead wood, Loo Choo Islands.

57. H. nivosa, Berk. & Curt.: nivea; pileo breviter campanulato demum expanso tenerrimo; stipite glabro; lamellis postice attenuatis approximatis subdistantibus.

Side of mountains, Bonin Islands. — Approaches *Mycena.*

58. H. Boninensis, Berk. & Curt.: pileo tenerrimo brunneolo striato; stipite delicato hyalino; lamellis remotis distantibus ventricosis albis.

Side of logs, Bonin Islands. — Also has the habit of *Mycena.*

59. H. gracilis, Berk. & Curt.: albus; pileo hemisphærico striato glabro; stipite gracili hyalino pulverulento-tomentoso; lamellis ventricosis remotis.

Decayed wood, Bonin Islands. — Closely allied to the last.

60. Coprinus subglobatus, Berk. & Curt.: pileo subgloboso pallide fusco indumento crasso subglauco vestito; stipite albo; lamellis latis liberis ex albo obscure purpurascentibus.

On banks, California. — Allied to *C. atramentarius.*

61. C. modestus, Berk. & Curt.: pileo tenerrimo glabro sulcato-fisso pallide purpureo; stipite gracili; lamellis linearibus liberis phæotis.

On decayed wood, Bonin Islands. — Resembles *C. hemerobius.*

62. Bolbitius Oryzæ, Berk. & Curt.: pileo campanulato obtuso viscido stipiteque valido albis; lamellis adnexis ex albo gilvo-purpurascentibus.

On decaying Rice chaff, Japan.

63. Cortinarius (Inoloma) Wrightii, Berk. & Curt.: pileo convexo umbonato innato tomentoso fusco; stipite subæquali fibrilloso

basi nitente-fulvo; lamellis crassiusculis distantibus postice rotundato-emarginatis.

Japan.

64. Hygrophorus pictus, Berk. & Curt.: pileo umbilicato depressove striato; stipite sursum incrassato glabro; lamellis distantibus subangustis ventricosis decurrentibus.

On the ground, Hong Kong.

65. Lactarius lividatus, Berk. & Curt.: pileo leviter depresso stipiteque sursum incrassato rufis; lamellis angustis subconfertis e sordide helvolis lividis.

On hills, Japan. — Has somewhat the habit of *L. volemus*.

66. Cantharellus Behringensis, Berk. & Curt.: pileo plano tomentoso adpresse-squamuloso griseo-albo; stipite sursum incrassato tenui; plicis lamellæformibus furcatis, adnato-decurrentibus.

Behring's Straits. — Resembles the white var. of *C. aurantiacus*.

67. C. nivosus, Berk. & Curt.: candidus; pileo galeæformi membranaceo subtiliter pulverulento; lamellis angustissimis hic illic anastomosantibus.

On dead stems of grass, Hong Kong. — Belongs to the same section as *C. retirugus*.

68. Marasmius cremoriceps, Berk. & Curt.: pileo umbilicato candido glabro; stipite cartilagineo sursum rufescente; lamellis decurrentibus cremoricoloribus.

Amongst dead leaves and grass, Japan. — Resembles *Agaricus phyllophylus*.

69. M. galeatus, Berk. & Curt.: candidus; pileo resupinato e pezizæformi galeato glaberrimo; lamellis e puncto centrali radiantibus.

On dead stalks, Japan. — Pileus looks like kid leather.

70. M. petalinus, Berk. & Curt.: albus; pileo hemisphærico expanso membranaceo striato; stipite hygrophano basi striguloso e strato corticioideo oriundo; lamellis paucis veniformibus adnexis.

On dead twigs and bark, Bonin Islands.

71. M. luteolus, Berk. & Curt.: pileo hemisphærico demum umbilicato luteo; stipite glabro floccis fulvis affixo; lamellis pallido-luteis ramosis distantibus adnexis.

On dead Palm-leaves, Bonin Islands. — Allied to *M. petalinus*.

72. M. luteo-fuscus, Berk. & Curt.: pileo hemisphærico umbilicato sulcato rugoso helvolo; stipite basi tomentoso sursum glabro hygrophano; lamellis subdistantibus adnatis flavo-albis.

On mountains of the Bonin Islands.

73. M. PARVULUS, Berk. & Curt.: pileo convexo striato delicato pulverulento albo; stipite capillari sericeo deorsum purpurascente; lamellis ventricosis liberis.

On the ground, Hong Kong. — Resembles *M. pusio*, B. & C.

74. M. DICHROUS, Berk. & Curt.: pusillus; pileo convexo albo glabro; stipite brevi deorsum rufescente capillari; lamellis paucis decurrenti-adnexis; interstitiis lævibus albis.

On dead sticks, Bonin Islands.

75. M. ALPHITODES, Berk. & Curt.: pusillus, albus; pileo demum plano stipiteque brevi farinosis; lamellis paucis; interstitiis lævibus.

On dead leaves of some Gingerwort, Bonin Islands.

76. M. SORDESCENS, Berk. & Curt.: pileo depresso striato ex albo umbrino; stipite insititio subtiliter velutino fusco; lamellis adnexis pileo concoloribus.

Dead twigs and leaves, Bonin Islands. — Has the habit of *M. perforans*.

77. M. GLABRESCENS, Berk. & Curt.: pileo convexulo depresso flavo primum furfuraceo-squamoso demum glabro; stipite pallidiore pulverulento-fibrilloso glabrescente; lamellis distantibus venoso-connexis adnexis flavis.

In shaded ravines, Bonin Islands.

78. M. UMBONIFER, Berk. & Curt.: pileo ex campanulato hemisphærico fortiter umbonato albido centro brunneo; stipite insititio polito glabro purpurascenti-brunneo; lamellis paucis collariatis albidis.

In shady ravines, Bonin Islands. — Allied to *M. rotula* and *Guyanensis*.

79. M. EXUSTUS, Berk. & Curt.: pusillus; pileo hemisphærico umbilicato sulcato brunneo-albo siccitate fusco; stipite brevi capillari insititio atro-fusco; lamellis paucis.

On dead leaves, Bonin Islands. — Nearly allied to the last.

80. M. ACICULARIS, Berk. & Curt.: pileo hemisphærico umbilicato sulcato rufo-luteo; stipite glaberrimo flavo insititio; lamellis paucis flavis adnatis.

On decayed wood, Bonin Islands.

81. M. ALUTACEUS, Berk. & Curt.: sordide alutaceus; pileo inflato campanulato, cute demum plicato-rugosa; stipite subtiliter pulverulento; lamellis paucis ventricosis; interstitiis lævibus.

Hong Kong. — Allied to *M. hæmatocephalus*.

82. M. ACICOLA, Berk. & Curt.: pileo e convexo subdepresso glabro striato brunneolo; stipite insititio glaberrimo rufo; lamellis angustis breviter adnatis albis.

On dead Pine leaves, Japan. — Approaches *Collybia.*

83. M. TENER, Berk. & Curt.: ex albo siccitate umbrinus; pileo hemisphærico striato subtiliter pulverulento; stipite demum glabro nitido non insititio basi parvula floccosa affixo; lamellis latiusculis adnatis.

On dead twigs, Bonin Islands. — Allied to *M. androsaceus.*

84. LENTINUS PYRAMIDATUS, Berk. & Curt.: pileo umbilicato fibroso; fibris in fasciculos pyramidatos stipatis margine involuto cirrhosis; stipite sursum tomentoso deorsum furfuraceo; lamellis incisis, omnibus una desinentibus.

On logs, Nicaragua. — Allied to *L. villosus.*

85. L. NICARAGUENSIS, Berk. & Curt.: pileo umbilicato strigoso; strigis cirrhosis subfasciculatis cervinis; stipite farinoso-tomentoso deorsum modo pilei strigoso; lamellis postice anastomosantibus.

On logs, Nicaragua. — Nearly allied to the two last.

86. PANUS INFUNDIBULUM, Berk. & Curt.: albus; pileo duro lobato infundibuliformi, margine tenui stipiteque excentrico sursum dilatato tomentosis; lamellis distantibus decurrentibus.

On dead trees, Nicaragua. — The surface of the pileus resembles that of *Lactarius vellereus.*

87. XEROTUS FULIGINOSUS, Berk. & Curt.: pileo reniformi tenui sursum e lateritio brunneo rugosiusculo parce striato; lamellis angustis antice ramosis vel anastomosantibus.

On dead twigs, Hong Kong.

88. X. FRAGILIS, Berk. & Curt.: pileo reniformi tenui e lateritio luteo-fusco striato; lamellis venoso-connexis, intermediis pluribus.

On decayed wood, Bonin Islands.

89. X. PUSILLUS, Berk. & Curt.: minutus; pileo reniformi conchato brunneo sulcato-striato; lamellis paucis alutaceis; interstitiis lævibus.

On dead Fern leaves, Hong Kong.

90. LENZITES JAPONICA, Berk. & Curt.: pileo dimidiato lobato albido zonato scabroso-hirsuto postice rugoso; lamellis tenuibus dentatis margine poriformibus; contextu niveo.

On dead wood, Japan. — Allied to *L. betulina.*

91. Boletus rhodomyces, Berk. & Curt.: pileo subviscoso brunneo; stipite brevi erythrino e mycelio roseo oriundo; tubulis compositis decurrentibus.

On shaded hills, Japan.

92. Polyporus (Mesopus) ochrotinctus, Berk. & Curt.: pileo e flabelliformi orbiculari ochraceo glaberrimo polito sulcato-zonato; stipite concolori nitente; hymenio albo, poris parvis rotundis.

On decayed wood, Bonin Islands and Japan.

93. P. pocula, Berk. & Curt.: pusillus, poculæformis; pileo umbrino farinaceo; stipite utplurimum verticali insititio; hymenio concavo pallido. (*Sphæria pocula*, Schwein.!)

On dead sticks, Nicaragua.

94. P. (Anodermei) nitidulus, Berk. & Curt.: pileis lateraliter connatis sublobatis brevibus demum rufescentibus nitidulis subzonatis, obscure lineatis; hymenio albo; poris minimis angulatis.

On dead wood, Bonin Islands.

95. P. (Placodermei) marmoratus, Berk. & Curt.: pileo convexo ligneo zonato subtiliter pulverulento laccato contextu hymenioque ferrugineis; poris minutis punctiformibus.

Nicaragua.

96. P. (Placodermei) linteus, Berk. & Curt.: durus, ponderosus; pileo dimidiato sulcato radiatim rimoso brunneo villo albicante dealbato, margine tenui; contextu ferrugineo; hymenio cinnamomeo; poris minutis punctiformibus.

On bark, Nicaragua.

97. P. Nicaraguensis, Berk. & Curt.: ungulatus; pileo ex albido pallide umbrino subtiliter tomentoso lævi, contextu umbrino; hymenio irregulari brunneo; poris minutis.

On dead wood, Nicaragua.

98. Hexagonia Thwaitesii, Berk. Herb.: cervina; pileo tenui glabro zonato unicolori hic illic lineatim rugoso; poris magnis concoloribus.

On dead wood, Bonin Islands. — Allied to *H. affinis*.

99. H. variegata, Berk. Herb.: pileo reniformi tenui zonato rigido variegato velutino glabrescente radiato-rugoso; hymenio umbrino; poris mediis.

On dead wood, Nicaragua.

100. Hydnum (Mesopus) Wrightii, Berk. & Curt.: fuscum;

pileo orbiculari lobato virgato sericeo vel tomentoso; stipite e fibris floccisque nigris oriundo; aculeis acutis elongatis.

Amongst leaves, Japan.

101. H. STALAGMODES, Berk. & Curt.: resupinatum, longe effusum, luteo-album; aculeis subulatis dependentibus fasciculato-connatis denticulatis ciliatis.

On decayed wood, Bonin Islands. — Somewhat like *H. membranaceum* and *udum*.

102. RADULUM RHABARBARINUM, Berk. & Curt.: resupinatum, effusum, irregulare, ferrugineum; tuberculis fasciculatis subcylindricis tenuibus, apicibus obtusis emarginatis.

On decayed wood, Nicaragua.

103. CRATERELLUS AUREUS, Berk. & Curt.: pileo submembranaceo tubæformi pervio subflocculoso, margine primum deflexo breviter fimbriato aureo; hymenio persistenter lævi glauco-luteo.

On the earth, Hong Kong. — Near *C. odoratus*.

104. THELEPHORA XERANTHA, Berk. & Curt.: pileo flabelliformi subzonato pulverulento-tomentoso lineatim rugoso in petiolum attenuato; hymenio subferrugineo.

On roots of trees, Hong Kong. — Allied to *T. laciniata*.

105. STEREUM NICARAGUENSE, Berk. & Curt.: pileo dimidiato rugoso inæquabili villoso zonato candido, contextu umbrino; hymenio cinereo, margine tenui umbrino.

On logs, Nicaragua.

106. S. SUBCRUENTATUM, Berk. & Curt.: pileo dimidiato conchiformi decurrente albido postice cruentato zonato; hymenio lævi ochroleuco.

On dead wood, Japan.

107. LASCHIA PEZIZÆFORMIS, Berk. & Curt.: minuta, alba, resupinata, pezizæformis, magine incurvo; poris rotundis.

On dead Palm-leaves, Bonin Islands. — We have the same from Venezuela.

108. CORTICIUM IRRIGATUM, Berk. & Curt.: pileo tenui reflexo leviter zonato rugoso-tomentoso hymenioque lævi cremoricoloribus.

Forming dense patches on rocks, Hong Kong.

109. C. ASCHISTUM, Berk. & Curt.: album, resupinatum, effusum, læve, continuum, subtiliter pubescens, margine demum liberato tomentoso.

On decayed logs, Nicaragua. — Near *C. puberum*.

110. C. RIMOSISSIMUM, Berk. & Curt.: effusum, resupinatum, cinnamomeum, a matrice separabile, rimosissimum, contextu rufo-albido.

On dead Cane, Nicaragua.

111. CYPHELLA EPILEUCA, Berk. & Curt.: galeæformis vel conchiformis, tomentosa, e strato corticioideo oriunda; hymenio lævi.

On dead panicles of *Areca*, Bonin Islands.

112. CLAVARIA DECOLOR, Berk. & Curt.: ex albo umbrina; stipite cylindrico e fibris ramosis oriundo sursum subdichotomo, ramis brevibus.

On hill-sides, Hong Kong. — Allied to *C. abietina*.

113. HYMENULA ATROVIRENS, Berk. & Curt.: linearis, subconvexa, atrovirens, sicca granulata.

On dead Canes, Nicaragua.

114. RHIZOPOGON PICEUS, Berk. & Curt.: imberbis; peridio demum piceo; gleba alutaceo-umbrina; sporis oblongis.

In steep banks, Hong Kong.

115. GEASTER BIPLICATUS, Berk. & Curt.: peridio exteriori tenui irregulariter multifido e mycelio floccoso oriundo; peridio interiori subgloboso nigrescente stipitato, basi stipitis e plicis peridii interioris impressa, ore plicato, apice fimbriato.

On the ground, Bonin Islands.

116. G. PAPYRACEUS, Berk. & Curt.: gregarius, e mycelio albo membranaceo oriundus; peridio externo extus subsericeo albo intus e rufo fusco 5 – 6 fido, interiori brunneo sessili; ore depresso sericeo-fibroso.

On decaying vegetable matter, under Pines; Japan. On rotten wood, Bonin Islands. We have it also from Ceylon.

117. BOVISTA DELICATA, Berk. & Curt.: pusilla, globosa; peridio exteriori verrucis minimis consperso, tandem rimoso-deglubente; sporis argillaceis subroseis longe pedunculatis.

On the ground, Hong Kong. — Resembles *B. cervina*, Berk.

118. LYCOPERDON PURPURASCENS, Berk. & Curt.: pusillum, subglobosum, e purpurascenti brunneum basi subaculeatum sursum innato-squamulosum; strato sterili obsoleto; sporis luteo-olivaceis.

On decayed logs, Bonin Islands. — Allied to *L. pusillum*.

119. L. HONGKONGENSE, Berk. & Curt.: pusillus, pyriformis, breviter radicatus, apice irregulariter dehiscens; capillitio subrufo; sporis ellipticis, pedunculatis.

On the ground, Hong Kong.

120. L. PLICATUM, Berk. & Curt.: parvum, subrotundum, ex albo pallide fuscum, subtus plicatum; epidermide verruculoso sursum fatiscente evanido; sporis lævibus brevissime pedunculatis.

On the ground, Japan.

121. LICEA STIPITATA, Berk. & Rav.: peridiis cylindricis ex incarnato rubidis stipite communi fusco intus celluloso suffultis.

On decayed logs, Bonin Islands. — Agrees exactly with South Carolina specimens from Mr. Ravenel.

122. L. RUBIFORMIS, Berk. & Curt.: conglomerata, coccinea; peridiis urceolatis apiculatis liberis, basi vesiculosa.

On decayed wood, Behring's Straits.

123. PHOMA ANGUINA, Berk. & Curt.: maculis parvis nigris hic illic confluentibus; peritheciis depressis; sporis subellipticis.

On dead stems of *Alyssicarpus bupleurifolius*, Behring's Straits. [Probably from Hong Kong. *Alyssicarpus* is not found so far north. A. G.]

124. SPHÆROPSIS ARCTICA, Berk. & Curt.: peritheciis erumpentibus elongato-prominulis papillæformibus vel subcompressis; sporis hyalinis fusiformibus.

On cones of *Pinus Ajanensis*, Kamtschatka.

125. SEPTORIA ARCTICA, Berk. & Curt.: peritheciis globosis, immersis, siccis collabentibus; sporis sursum attenuatis, linearibus, 3–7 septatis.

On culms of *Dupontia Fischeri*, Arakamtchetchene Island.

126. S. BONINENSIS, Berk. & Curt.: peritheciis minutis epidermide nigrifacto polito ocellato tectis; sporis rectis mediis filiformibus curvulis.

On petioles of an unknown leaf, Bonin Islands.

127. S. PHOTINIÆ, Berk. & Curt.: peritheciis epidermide nigrifacto medio ocellato tectis; sporis rectis brevibus linearibus.

On leaves of *Photinia*, California.

128. DISCOSIA OSTIOLATA, Berk. & Curt.: peritheciis elevatis; ostiolo distincto prominulo perforato; sporis 3-septatis.

On dead leaves, Bonin Islands.

129. TRIPHRAGMIUM BINATUM, Berk. & Curt.: sporis fuscis bicellulosis spinis emarginatis asperis; dissepimento verticali; membrana exteriore deglubente.

On leaves, with *Lecythea pezizæformis;* Nicaragua.

130. Puccinia triarticulata, Berk. & Curt.: soris oblongis epidermide rimoso arcte inclusis; sporis elongatis triarticulatis breviter pedicellatis.

On *Elymus mollis*, Behring's Straits.

131. P. dochmia, Berk. & Curt.: soris oblongis; sporis brevibus obtusissimis fuscis; pedunculo hyalino laterali.

On leaves of Grasses, Nicaragua.

132. P. sepulta, Berk. & Curt.: maculis orbicularibus, supra bullatis brunneis, subtus concavis; soris congestis in massam uniformem, partim e pilis matricis celatis; sporis obtusis pedunculatis.

On leaves of *Ficus?* Nicaragua.

133. Uromyces Lupini, Berk. & Curt.: hypo-epiphylla; soris irregularibus; sporis brunneis papilla crassa terminatis; pedunculo spora longiore.

On leaves of *Lupinus*, with No. 137; California.

134. U. Japonica, Berk. & Curt.: maculis orbicularibus; soris solitariis vel circinantibus; sporis ovatis, apiculo terminali hyalino; pedunculo brevi, externa membrana evanescente.

On leaves of an *Orchid?* Japan.

135. U. Statices, Berk. & Curt.: hypo-epiphylla; soris amplis concentricis epidermide cinctis; sporis obtusissimis.

On leaves of *Statice*, California.

136. Uredo asperata, Berk. & Curt.: maculis obsoletis; soris sparsis gregariisque hypophyllis oblongis vel fusiformibus pallidis granulatis.

On leaves of *Xanthoxylum*, Bonin Islands.

137. U. Lupini, Berk. & Curt.: hypo-epiphylla; maculis nullis; soris sparsis irregularibus epidermide rupto cinctis; sporis brunneolis subglobosis lævibus.

On leaves of *Lupinus*, California.

138. U. Bauhiniæ, Berk. & Curt.: hypo-epiphylla; maculis nullis; sporis fuscis subglobosis echinulatis, membrana interna sæpe polyhedricontracta.

On leaves of *Bauhinia*, Nicaragua.

139. U. constellata, Berk. & Curt.: maculis pallidis, oppositis nullis; soris minutis tarde ruptis constellatis; sporis argillaceis decolorantibus verrucoso-aculeatis.

On living leaves, Hong Kong.

140. Lecythea pezizæformis, Berk. & Curt.: soris minutis pezizæformibus extus albis intus fuscis; sporis obovatis echinulatis.

On under side of leaves, Nicaragua.

141. Æcidium Capense, Berk. & Curt.: maculis nullis; peridiis elongatis cylindricis apice dilatatis dentatis.

On the fruit of an *Asparagus* or some allied plant, Cape of Good Hope.

142. Helicoma fasciculatum, Berk. & Curt.: floccis fasciculatis hic illic subconnatis parce articulatis; sporis quadriarticulatis.

Under side of dead leaves, Japan.

143. Cladosporium pallidum, Berk. & Curt.: maculis orbicularibus pulveraceis; floccis erectis simplicibus; sporis oblongis sinuatis.

On leaves, Nicaragua.

144. Campsotrichum circinatum, Berk. & Curt. mss.: atrum, floccis apice cirrhiformibus.

On dead leaves, Bonin Islands. South Carolina specimens are on leaves of *Magnolia grandiflora*.

145. Helvella pusilla, Berk. & Curt.: pusilla; pileo deflexo libero brunneo subtus griseo; stipite glaberrimo fistuloso cartilagineo.

On sandy flats, Behring's Straits. — Very distinct.

146. Peziza Japonica, Berk. & Curt.: fusco-atra; cupulis congestis subpedicellatis plicato-rugosis, e floccis brunneis in fasciculum unitis oriundis.

On roots, Japan. — Allied to *P. melæna*.

147. P. Boninensis, Berk. & Curt.: media; cupula plana glabra extus alba intus pallide rufa; sporidiis subcymbiformibus.

On dead leaves, Bonin Islands. — Allied to *P. rutilans*.

148. P. insititia, Berk. & Curt.: cupula alba anguste cyathiformi subcostato setoso, margine squamis setiformibus ciliato; stipite deorsum attenuato sulcato farinoso; hymenio pallide flavo; ascis longissimis; sporidiis maximis cymbiformibus.

On dead wood, Bonin Islands. — Allied to *P. tricholoma*, Mont.

149. P. lepida, Berk. & Curt.: media; capula infundibuliformi e stipite sursum attenuato gradatim oriundo, margine inflexo furfuraceo, disco coccineo.

On burnt earth, Japan. — Allied to *P. coccinea*.

150. P. verruculosa, Berk. & Curt.: atropurpurea, rigescens, sessilis vel breviter pedicellata, cupulæformis vel explanata, extus verruculis pyramidatis margine pulverulentis aspera.

On stony hills, Behring's Straits. — Somewhat resembling *P. nigrella.*

151. P. PORPHYRA, Berk. & Curt.: sessilis; cupula planiuscula, extus fusca velutina, intus atropurpurea; sporidiis globosis; paraphysibus furcatis.

On roadside banks, Japan. — A splendid species.

152. P. LEUCOPHÆA, Berk. & Curt.: cupula concava, intus alba, extus floccis brunneis subfasciculatis aspera; sporidiis longis filiformibus.

On dead sticks, Japan.

153. P. INCONSPICUA, Berk. & Curt.: subsessilis; cupula hemisphærica, margine incurvo, extus albo pruinoso, intus luteolo.

On dead wood, Bonin Islands.

154. P. HONGKONGENSIS, Berk. & Curt.: breviter stipitata; cupula hemisphærica subtus lutea, margine incurvo; hymenio convexulo vel plano aurantiaco.

On dead twigs, Hong Kong. — This pretty species belongs to the claviform section of *Mollisia.*

155. HYPOCREA ARMENIACA, Berk. & Curt.: armeniaca, omnino superficialis, convexa, basi orbiculari affixa; ostiolis fuscis.

On living leaves of *Apocyneæ*, Bonin Islands.

156. DIATRYPE CATERVARIA, Berk. & Curt.: stromatibus parvis in maculas aggregatis papilla centrali notatis, quandoque confluentibus; ascis brevibus; sporidiis globosis. — *Sph. catervaria*, Berk. Herb.

On leaves of *Ficus*, Hong Kong. — Also in Ceylon.

157. SPHÆRIA (Connatæ) PARDALIOS, Berk. & Curt.: subiculo ex albo citrino subceraceo; peritheciis mediis e brunneolo nigris; ostiolo papillæformi.

On dead wood, Bonin Islands. — Allied to *S. confluens.*

158. S. CULCITELLA, Berk. & Rav. Fung. Carol.: subiculo aterrimo; fibris repetiter dichotomis, apicibus furcatis; peritheciis minutis subglobosis glabris.

On dead wood, Nicaragua.

159. S. (Denudatæ) DEPOLITA, Berk. & Curt.: peritheciis subglobosis basi applanatis politis nigerrimis; ostiolo minuto papillæformi.

On Palm leaves, Bonin Islands.

160. RHYTISMA ERYTHROSPORUM, Berk. & Curt.: stromate tenui piceo hic illic in papillas elevato; ascis amplis; sporidiis salmonicoloribus magnis rectis vel curvulis utrinque apiculatis.

Both sides of leaves of *Quercus virens* [*agrifolia?*], California. Remarkable for the size and color of the sporidia.

161. DOTHIDEA PERMEANS, Berk. & Curt.: maculis irregularibus substellato-orbiculatis nigris totam matricem permeantibus elevato-subrugosis; ostiolis indistinctis.

On leaves, Nicaragua.

162. D. TENUIS, Berk. & Curt.: picea; stromate subpenetrante tenui supra e cellulis prominulis minute granuloso; sporidiis hyalinis oblongo-clavatis.

On leaves of *Bauhinia*, Nicaragua. — Allied to the preceding.

163. D. PLATYPLACA, Berk. & Curt.: stromate tenui nigro totam matricem penetrante supra nitido subtus fertili opaco; cellulis superficialibus.

With *D. permeans.* — In some respects resembling *S. demersa*, Corda.

164. D. INCLUSA, Berk. & Curt.: stromate punctiformi margine e matrice formato incluso; cellulis subsolitariis; sporidiis fusiformibus ellipticis.

On leaves of *Jacquinia*, Nicaragua.

165. ASTERINA VELUTINA, Berk. & Curt.: maculis velutinis orbicularibus fibris erectis subulatis obsitis; peritheciis minutissimis frequentibus; ascis oblongis; sporidiis oblongis uniseptatis.

On leaves, Loo Choo Islands.

166. A. OSTIOLATA, Berk. & Curt.: punctiformis, niger; subiculo nullo nisi peritheciali; ostiolo distincto papillæformi.

Upper surface of leaves, with *Cephaleuros virescens;* Nicaragua.

167. A. SEPULTA, Berk. & Curt.: subiculo repente epidermide diu tecto; peritheciis minutis; ascis oblongis; sporidiis uniseptatis.

On leaves of some *Laurinea*, Japan.

168. A. MEGALOSPORA, Berk. & Curt.: subiculo parcissimo fimbriante; peritheciis magnis hiantibus; sporidiis maximis uniseptatis.

On living leaves, Bonin Islands. — Resembles *A. Azarræ*, Lev.

169. A. CONGREGATA, Berk. & Curt.: peritheciis minimis nitidis congregatis; subiculo parcissimo; ore rotundo; ascis helvolis; sporidiis angustis.

On dead leaves, Nicaragua. — Has the habit of *Sph. maculæformis.*

170. A. BULLATA, Berk. & Curt.: maculis orbicularibus e matrice elevata enatis, filis in stratum compactum tenue hic illic cellulosum intertextis; peritheciis prominulis.

On dead leaves, Nicaragua. — Has the habit of *Strigula*.

171. Meliola dichotoma, Berk. & Curt.: subiculo velutino; peritheciis magnis, appendiculis uni-bifurcatis, ramulis elongatis.

On leaves of some climbing plant, Japan.

CYSTOTHECA, Berk. & Curt.

Perithecia globosa, e floccis rigidis brunneis oriunda. Ascus unicus, sacculo hexagono-celluloso circumdatus. — Genus pulcherrimum *Myxothecio*, *Pisomyxæ*, &c. affine, foliis innascens.

172. Cystotheca Wrightii, Berk. & Curt. Forming thin chocolate-colored patches on the under surface of leaves. Perithecia globose, $\frac{1}{400}$ inch in diameter, containing a single hyaline, globose, beautifully reticulate sac, within which is an ascus of the same form. Sporidia in our specimens imperfect.

173. Ascomyces deformans, Berk. Mss. (Vide Gard. Chron. 1856, p. 470): candidissimum, compactum, matricem deformans.

On *Trientalis*, Petropaulowski, Kamtschatka.

174. Sphæria Cullumiæ, Berk. & Curt.: primum epidermide tecta, subpustulata, demum nuda, subglobosa, obtusa, ore minutissimo perforata; ascis brevibus curvis; sporidiis biseriatis clavato-lanceolatis demum uni-triseptatis.

On leaves of *Cullumia squarrosa*. Cape of Good Hope. — Sporidia at first simple, then binucleate, at length uniseptate, or very rarely triseptate, brown, $\frac{1}{1500}$ inch long, lanceolate, but broader at the upper end. — On the same leaves there is a minute *Leptostroma*, but without fruit.

Four hundred and fifty-eighth meeting.

January 11, 1859. — Monthly Meeting.

The President in the chair.

The Corresponding Secretary read letters from the War Department, accompanying Vols. II.-VIII. of the Pacific Railroad Surveys; from the Minister of the Interior of the Netherlands, presenting folio 14 of the Geological Maps of Holland; and from Dr. I. I. Hayes of Philadelphia, acknowledging the receipt of a copy of the resolutions of the Academy upon the subject of his proposed Arctic expedition.

Professor Gray gave a series of illustrations of the Botany of Japan in its relations to that of Central and Northern Asia, Europe, and North America, — the communication being a portion of one of the papers presented by him at the last preceding meeting.

He showed that the relations of the Flora of Japan with that of the United States east of the Mississippi were peculiarly intimate, as evinced by the great number of congeneric, of closely representative, and of identical species in the two floras, noting especially that most of the more striking points of similarity were presented in species or in types which are absent from the flora of Europe. Also, that although there is a considerable number of species common to the western side of the American continent and to Japan, yet that the likeness was less strong between their floras than between those of Eastern North America and of Japan, although the latter are geographically separated by about one hundred and forty degrees of longitude. Also, that far more Eastern American species or types are represented in Eastern Asia, than of Western American in Europe, or even in Asia; — thus pointing to a remarkable interchange between the floras of Eastern North America and Eastern Asia; or to a former homogeneousness of the temperate American and East-Asian floras, to a degree equal, perhaps, to that of the Arctic or the sub-Arctic flora at the present time.

Comparisons formerly instituted by Professor Gray between the flora of the Northern United States and that of other parts of the northern temperate zone had already suggested to others, as well as to himself, the inference that the interchange between these floras had taken place mainly *via* Asia, and not *via* Europe; and it would be seen that our now largely increased knowledge of the botany of the Japanese and of the Himalayan regions strengthened this inference.

In presenting the subject, Professor Gray could hardly avoid using the words "interchange" and "dispersion of species." He had used them only in drawing his conclusions from the facts, and wished to do so without prejudging the question involved. But he was free to say that the present investigation had confirmed his impression that such terms were properly employed. For although some of these facts would at first seem most readily explicable upon the supposition of the double origin of those species whose present geographical areas are widely dissevered, yet, in his opinion, they would be found, on considering the whole case, far more conformable to the hypothesis of a single local origin for each species at an early time. And in his opinion the actual question now is, — whether each species originated in one local area, whence it has spread, as circumstances permitted, over more or less broad tracts, in some cases becoming discontinuous in area through changes in climate or other physical conditions operating during a long period of time; or, whether each species originated where it now occurs, probably in as great a number of individuals occupying as large an area, and generally the same area, or even the same discontinuous areas, as at the present time. The latter is understood to be the view of Professor Agassiz.

To this view Professor Gray objected: — 1. That it offers no *scientific* explanation of the present distribution of species over the globe; but simply supersedes explanation, by affirming, that as things now are, so they were at the beginning; whereas the facts of the case — often very peculiar — appear to demand from science something more than a direct reference of the phenomena as they are to the Divine will.

2. That the idea of the descent of all similar or conspecific individuals from a common stock is so natural, and so inevitably suggested by common observation, that it must needs be first tried upon the problem; and if the trial be satisfactory, its adoption would follow as a matter of course.

3. That, since it is conceded that the present era of the world is of extremely long duration, and since it is most probable, not to say certain, that the existing species of plants of the regions in question, or a part of them, are of

high antiquity, dating back to the post-tertiary, or even to the later tertiary epoch, — and therefore must have been subject to great climatic changes, accompanied or caused by no inconsiderable changes in the relative extent and configuration of the land, — the objections formerly raised against such wide dispersion of species lose most of their force. And the explanation of such anomalies in the actual distribution of species is to be sought in the vicissitudes to which the species must have been subject in their earlier days.

Professor Gray proceeded briefly to intimate, that, if the present flora of the northern hemisphere preceded the glacial period, or even immediately succeeded it, the actual distribution of species, and the interchange between this continent and Eastern Asia under similar parallels of latitude, could be readily accounted for on the ordinary view; or at least would offer no greater difficulty than the Arctic flora now does, — the general homogeneousness of which round the world has never been thought difficult of explanation. He proposed to illustrate his views upon this part of the subject at a future meeting.

Professor Agassiz remarked, that the animal kingdom presented a resemblance between its representatives of Eastern North America and Eastern Asia similar to that mentioned by Dr. Gray in the flora, and that he has especially pointed out this correspondence in detail in the order of Testudinata, in his Contributions to the Natural History of North America. He acknowledged the correctness of the views ascribed to him by Dr. Gray, and would defend them on the ground that, connecting the present state of things with that which prevailed in earlier geological periods, it could be shown that the present distribution of animals was linked with that of earlier periods in a manner which excluded the assumption of extensive migrations, or of a shifting of the floræ and faunæ from one area to another.

He viewed the similarity between the fauna of Northeastern America and that of Northeastern Asia, not as the result of climatic changes over an area primitively more homogeneous in its organic productions and modified by climatic changes, but as a primitive adaptation of organic types to similar corresponding physical features, which have remained respectively unchanged since the first introduction upon earth of these organisms. Admitting with Dr. Gray the immensely long duration of even the present period, he did not think that the regular order and organic connection which everywhere exist between the different types of animals and plants upon the whole surface of our globe, could have been established by physical changes, or even essentially modified by them. With reference to the single origin of conspecific individuals, he thought that the warfare which so many species wage upon others was in itself an insuperable objection to the assumption that any one species could have originated in a single pair.

The President remarked, that the appearance of the same species on different or opposite parts of the globe admitted of explanation by supposing that originally a zone, or isothermal belt, which existed in each climate, contained all the species capable of flourishing in that climate so long as the climate remained stationary; and that in the lapse of ages a great portion of these plants had disappeared or died out, under the casualties to which plants are liable, some having disappeared altogether, and others remaining only in localities, defined by longitudes, in different parts of the same zone; so that at the present day, while the general character of the vegetation is different in different hemispheres and countries, still a sufficient number of species might be extant in, and common to, both hemispheres, to represent a part of the original growth. This explanation appeared to him more probable than the supposition that these plants had more recently migrated from any one country to its antipodes, passing over the intermediate regions.

Professor Gray rejoined, that his views would in a good degree harmonize with those of the President, with the important exception that he regarded any former more homogeneous state of the temperate flora as itself a resulting, not an original condition. Still less, therefore, could he coincide with Professor Agassiz, in regarding the actually present distribution, with all its dislocations, as a primitive state. Whether a much larger number of species than now were ever common to Japan and to New England, and whether these at any one time inhabited the whole intermediate ground, appeared to him uncertain, and was unnecessary to suppose; but he had no idea that *recent* migration had anything to do in accounting for the present existence of the same species in such widely separated stations.

Four hundred and fifty-ninth meeting.

January 26, 1859. — Stated Meeting.

The President in the chair.

The Corresponding Secretary read letters from the Royal Belgian Academy, Brussels, acknowledging the reception of publications from the American Academy, and presenting its own recent Memoirs. Also, a letter from the President of the Royal Bavarian Academy of Sciences, Munich, announcing the intended celebration of the centennial anniversary of the foundation of that society on the 28th of March ensuing, and inviting the participation of the American Academy.

On motion of Mr. Winthrop, seconded by Professor Felton, Dr. Charles Beck, being now in Europe, was appointed to represent this Academy upon that occasion.

Professor John Lindley was elected a Foreign Honorary Member, in Class II. Section 2 (Botany), to fill the vacancy made by the decease of the late Robert Brown.

Sir William E. Logan, Director of the Geological Survey of Canada, was elected an Associate Fellow, in Class II. Section 1 (Geology, &c.).

William Watson Goodwin, Ph. D., of Cambridge, was chosen a Resident Fellow, in Class III. Section 2 (Philology, &c.).

On motion of Mr. Henck, a special appropriation of two hundred dollars was made, for the purchase by the Library Committee of additional works upon mathematics, technology, and engineering.

On motion of Professor Agassiz, special meetings for scientific discussion were voted to be held, at the hall of the Academy, on the fourth Tuesday of February, March, and April ensuing.

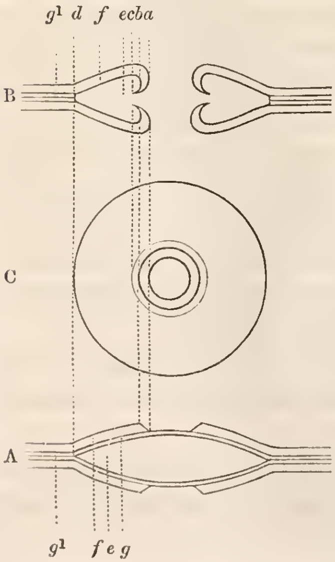
Professor Peirce made a further communication upon the tail of Comets, especially of Donati's Comet.

Mr. H. J. Clark read the following paper upon the use of the microscope, as recently improved, in the investigation of the minute organization of living bodies: —

"I was incited to bring together my thoughts and experiences upon this subject, by discovering, three or four months ago, a novel feature in the so-called glandular dots of the wood of our common White Pine (*Pinus Strobus*, Linn.).

"A dot of this kind is usually represented by a circle (Fig. 1, C, *d*), in the centre of which is a single or double ring (*a*, *b*), which has about one third the diameter of the first (*d*). The outer circle (*d*) is described as the boundary of a lenticular space (A, *e*) between two *contiguous cells*, and the inner double circle (C, *a*, *b*) as the outskirts of a perforation (A, *a b*) in the deposit layer (*f*) of the cell. The double circle arises, as is said, from the fact that the perforation has the shape of an extremely short truncate cone, which, when viewed endwise, presents to the eye its two circular ends concentrically; the broader end, which is always next the interior of the cell, corresponding to the outer (*b*), and the narrower end to the

Fig. 1.



inner circle (*a*). Thus are these dots described and illustrated, by Mohl, Schleiden, and Schacht, as seen in the common European Pine (*Pinus sylvestris*), and thus did they always appear to me, not only in that species, but also when I observed them in *Pinus Strobus*, except with this difference, that the perforation was bounded by an exceedingly faint third circle (C, *c*), whose relations I could not comprehend, nor was I able to reconcile its presence with the theory in regard to the nature of the perforation. I therefore left it, doubtingly supposing it to be some optical illusion. The microscope which I used, and which I have been in the habit of using up to within the last six months, is an Oberhaeuser's, made for Professor Agassiz some years ago; and yet at this very day I find it as good, with perhaps a single exception, as any now made in Germany, and therefore just as trustworthy in the investigation of the glandular dots of the Pine.*

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* It may not be uninteresting to state here, that the first great microscope made in Germany was constructed in 1829 by Fraunhofer, for Professor Agassiz. This microscope was represented in a copper-plate engraving, and described by Döllinger in the Memoirs of the Munich Academy for 1829, or 1830. In January, 1831, Agassiz went to Paris, and having given unlimited orders to Oberhaeuser for the best microscope that could be furnished, according to the knowledge of those times, he received from that maker, in 1832, an instrument which has not been surpassed in all Germany to this very day; at least, I have never seen any work from the hands of the best observers there, whether zoölogists, histologists, physiologists, or botanists, which could not have been accomplished just as well by this microscope. There may be one exception to this of a very recent date, but I am acquainted with the instrument only through report. With this masterpiece of Oberhaeuser Agassiz has gone on to this time, doing his great work with remarkable success, as all the world knows. Of late years it has become evident to Agassiz that his instrument was not equal to the demands which the progress of his researches put upon it; that there was something beyond its reach, of which he now and then could get a glimpse, just enough to warrant him in the belief that the study of the intimate structure of organized bodies had hardly begun.

So long ago as 1852 he had opportunities to see the workings of an instrument of the English pattern, made by Spencer; and although it was known as a rival, if not superior to the Transatlantic microscopes, he did not become convinced that it came up to his requirements.

Two or three years later I had the pleasure of bringing to his notice the results of some of my own researches upon the value of recently constructed objectives of English make. This gave him renewed hope, and, having heard of Spencer's continued rivalship and growing superiority, he determined to test his skill to the utmost. He therefore, in 1857, requested me to visit Canastota, in order to consult Spencer, and advise him as to the nature of the work for which we wished to use

"For the last six months I have used one of the most recently improved microscopes, made by Mr. Charles A. Spencer of Canastota, N. Y.; and with this, between three and four months ago, I again attempted to solve the mystery of the glandular dots. This I did with the most complete success.

"When the focus was brought to bear upon the inner surface of the dot, the innermost ring (B, C, *a*) of the perforation appeared first; a little deeper, the next outer one (*b*) came into view, whilst the innermost (*a*) disappeared; and still deeper the last (*b*) passed from my sight, and the faint ring (*c*) of my old observations came out sharply and clearly, as an exterior circle to the two others.

"I also observed, when passing from the innermost circle (*a*) to the outermost (*c*), that the widening was gradual; and so, too, did it appear in the transit from the second ring (*b*) to the outermost (*c*). This gave me the clew to the whole structure. I saw that these rings were not the expression of a simple perforation, but of the outwardly curled edge of this aperture, shaped in such a way as to form a sort of trumpet mouth.

"Although I would not trust to a transverse section alone, yet I found that it confirmed me in my views as explained above. The figures which I have given, — namely, a transverse section (B) with dotted lines projected upon a face view (C) of the dot, — I think will suffice to illustrate what I believe to be the true relations of these rings.

"Now, why was it that the Oberhaeuser instrument would not divulge these relations, when the microscope of Spencer succeeded so satisfactorily? This I will explain by showing the difference be-

his instruments. This consultation resulted in the conclusion that we must have three sets of objectives; — one, with the extremely flat field; a second of the like kind, but so put together as to allow working with it plunged in water; and the third with a depthing focus extending as far as possible beyond that of the ordinary kind, for the purpose of viewing objects as a whole, in order to ascertain the relations of their different parts. And now Spencer is devoting those extraordinary abilities, which show him to be a man of genius, to the construction of a microscope which shall embody not only the optical excellences of the different systems of lenses required for the various modes of investigation, but also those conveniences of mounting which the long use of that instrument has taught us, to facilitate the researches upon the living being in its normal condition, in its element, that we may be no longer compelled to represent the tortured figures of a crushed body or dismembered organism.

tween the objectives of the two microscopes. I will compare the action of the objective of Oberhaeuser to the manner in which a plano-convex lens treats the rays of light which pass through it, from any object. Those rays which pass near its axis are brought to a focus at the farthermost possible point from the lens, whilst the rays which pass through the periphery are converged at a much nearer point, and between the axis and periphery there are all degrees of convergence. The difference between the farthermost and nearest points of convergence may represent the distance or depth through which the objective takes cognizance of things, and will account for the fact that I saw all the rings of the Pine-dot at one time.

"The action of the objective of Spencer's microscope may be compared to that of a parabolic lens, which converges all the rays of light to one absolute plane, and therefore forms what is called a *flat field.*

"Now out of this field, either above or below its horizon, it is not possible to see anything, and on this account, when the innermost ring (B, C, *a*) of the dot was in view, the others were not to be observed; and when the field was lowered to the second ring (*b*), the innermost one (*a*), being above the horizon of the field, was invisible; and, again, when the outermost and lowest ring (*c*) was reached, the middle one (*b*) also vanished.

"Were this outermost ring as distinct as the others, it might have been possible to detect its relations by means of the Oberhaeuser; but since it is the exceedingly delicate, reverted edge of the perforation, the narrow aperture of this ordinary objective does not admit sufficiently oblique rays to define it, to say nothing of its being confused with the other rings which are in view at the same time.

"I would here remark, that this peculiar structure is most frequently to be observed in old wood, when the cell-wall (B, g^1) has also become perforated, and even has retreated from the deposit layer as far back as the edge of the lenticular interspace. In young wood the perforation corresponds with the figures usually given. I have used this discovery, not only to show how little may be understood of the structure of a familiar and much treated of body, but also as a preliminary illustration of the exceeding value of a flat field and a wide angle of aperture in microscopic investigations.

"But this is not the first example which has occurred to me. As far back as a year ago last summer I visited Mr. Spencer, and spent several days with him in testing his objectives with the tissues of every creature which we could find. I shall never forget the astonishment and delight with which I occupied day after day, plunged into the hitherto unknown depths of organic life. I say this after having tested from time to time some of the best English microscopes which have been made since the 'Great Exhibition,' and therefore am not to be supposed to have made so great a leap as if from an Oberhaeuser to a Spencer. Since that visit, and another one also, made last summer, when I obtained one of Mr. Spencer's quarter-inch objectives, with an angular aperture of one hundred and forty-five degrees, I have from time to time made particular efforts to test the value of the flat field and wide angle in the study of organized bodies. The results of my investigations at Canastota, and also since my return, I have embodied in this paper.

"One of the most valuable properties of the flat field is, that it enables one to study an isolated cell, in a manner totally unexpected to me, making it possible to obtain a section of such a body at any horizon, as if it were actually cut across. As I have said before, the flat field ignores everything above and below its horizon, and therefore, if it is brought on a level with the equator of a spherical cell, the largest possible circle is obtained, and the actual thickness of the wall becomes apparent; and if it is raised or lowered, the circle grows smaller and the wall seems thicker, because of the obliquity of the section, and yet appears as distinct as the one at the equator. This may go on until the field approaches very closely to the upper or lower side, and then the inner surface of the cell appears. In an ordinary microscope, the far-reaching power of the objective utterly precludes the possibility of such a process of investigation.

"The relations of the Purkinjean vesicle to the yolk, and the number and position of the Wagnerian vesicles, have always been difficult subjects to work out with the ordinary microscope. If the Wagnerian vesicle was situated at the upper or lower side of the Purkinjean vesicle, it has often been next to impossible to tell whether it might be really within the latter, or was one of the very similar yolk-cells outside. There are many other instances of the like kind too numerous to mention. All this difficulty I have seen obviated by the decided, section-like precision of the flat field, which at once revealed to the eye the exact and relative level of every vesicle or yolk-cell.

"I was most forcibly reminded, not long ago, of the value of the wide angle of aperture, and the accompanying great amount of light, upon trying Spencer's objective upon the stem of a well-known Hydroid, the *Clava leptostyla*, Ag. In the manuscript of the forthcoming volume of Professor Agassiz's "Contributions to the Natural History of the United States of America," the outer wall of this Hydroid, and of several others, I may say in passing, had been described as a structureless membrane; but what was my surprise, in my last attempt, to find that this wall was composed of a layer of polygonal cells, as distinct as any in the other parts of the animal, and even readily discernible in the more opaque parts, where the stem appeared like a simple black surface under the ordinary microscope.

"In regard to the usually estimated worth of wide angles of aperture, I would say, that, from numerous experiments upon living tissues, objectives having this property are valuable, not so much because they can admit extremely oblique one-sided rays, but because they allow rays to enter from all sides at a very wide angle to the axis. One-sided oblique rays throw the shadow, in a great measure, beyond any particular cell upon its neighbor, and this produces distortion; whereas when the rays converge at a wide angle, each cell becomes strongly marked at its periphery by a dark, broad shade. A moderately oblique, one-sided light, hardly twenty degrees from the axis of the objective, always appeared to be the most frequently serviceable. I was surprised one day to find that the hitherto faintly visible circulation in the cells of Spirogyra was rendered, by such a light, very distinct, and the granules borne along in the current appeared like little specks with a very sharp, thick, black outline.

"At first thought, there would appear to be an insuperable objection to the wide angle of such objectives, and that is the shortness of the working distance, which will not allow one to take anything more than a superficial view of a body, even of moderate thickness. But this objection has not the least force, and, on the contrary, the more nearly absolutely flat the field is, especially in the lower powers, such as the $\frac{1}{2}$, $\frac{2}{3}$, and 1 inch, the better will they bear the use of the higher eye-pieces. This is not a speculative suggestion, for I have been told by Mr. Spencer, that he has been able to see the lines upon

Pleurosigma angulata with a one-inch objective of his make. Now nothing but the enormously wide angle and the remarkably flat field which he has introduced in such a low power, could enable one to solve such a finely marked Diatom. Only a few years ago this little unicellular plant was a test object for the highest powers of the best microscopes.

"But if this image, or the image of any minute body, is to be magnified to any extent which may be required, by the use of the higher eye-pieces, the latter must be most exquisitely corrected, as regards their spherical and chromatic aberration, or else everything comes to the eye in a distorted state. On this account the Huyghenian ocular is not fit to be used, since it lacks just what we need here. I have for several years past asserted that the next step in the increase of the magnifying powers of the microscope would be accomplished by the construction of a new form of eye-piece, which would augment the image formed by the objective to an almost unlimited extent. At last I am happy to find my prediction verified, in the most practical manner, by the 'orthoscopic ocular' invented by Spencer. With such a range of powers, then, there is hardly any body of moderate transparency but what may be minutely investigated to its very core. If a subject is too thick for the short working distance of the higher powers, a lower objective may be used, and the higher oculars applied to make up the deficiency. Of course I do not mean to say that a certain amplification obtained by a low objective and a high orthoscopic ocular is fully as good as the same afforded by a higher objective; but in case the latter cannot reach a certain internal structure, the former can be used, with very little appreciable difference, and is by far better than the usual methods employed in such cases, such as pressure or dissections and the isolation of the organ to be investigated.

"I have not had an opportunity to make frequent use of the 'orthoscopic eye-piece'; but Mr. Spencer has furnished me with another form of ocular, the 'solid eye-piece,' invented by his pupil, Mr. Tolls. This, Mr. Spencer tells me, so closely approaches the 'orthoscopic eye-piece' in quality, that none but a very experienced eye could detect the difference, and the former excels the latter in the admission of light, because it has fewer reflecting surfaces. With this ocular and a quarter-inch objective I have run the magnifying power up to two thousand diameters, with wonderful results, which fully justify me in saying all that I have in regard to the study of thick tissues with low powers having wide angles of aperture.*

"I will take a young fish as an example to illustrate the remarkable efficiency of the flat field. In a view from above, one may see no less than six or seven different layers or sets of organs resting one over the other; first the skin and the muscular layer, next the vertebræ, within these the spinal marrow, and below the latter the chorda dorsalis, and close to this the dorsal artery, then the intestines and their appendages; and yet every one of these may be plunged through and totally ignored, on account of the peculiar properties of the flat field, and the last, the intestines, minutely inspected, not only cell by cell, but each cell may be studied, in every particular of detail, as if it were isolated. And so may any set of organs be treated, whether situated above or below in the animal. With such means at hand, as long as cells may be seen with a very moderate light, it is utterly preposterous to trust what may be worked out by separating these organs from the animal, piecemeal. When intact, every cell may be measured, not only transversely, but also with the greatest nicety in a perpendicular direction, by the micrometer screw, which works the fine adjustment of the objective; every cell, indeed, may be treated as if it were a separate body; but who would warrant to measure, for instance, the size of the cells of a nerve after it had been removed from its natural position, and with more or less inevitable distortion? Unfortunately, investigators have been compelled to do this too often, up to this very day; but now I hope for much better and more trustworthy results.

"In Embryology, how beautifully this almost transcendental definition of the objective applies! All the cells of an embryo of a certain age may be represented by a circle, with a smaller circle within known as the mesoblast (nucleus). At successively later ages we find the

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* In this connection I would urge upon students the necessity of avoiding the higher powers of the microscope in the commencement of their studies. When they have learned to use the lower objectives, it will be a much easier matter to master the higher ones. Students usually suppose that they can see everything with the higher powers, whereas they are greatly mistaken; as much as one would be who should make a minute inspection of the stones of some great architectural pile, and then think he had obtained a proper conception of its magnificent plan and glorious proportions.

cells of the nerves, for instance, simply oval, as the first step to elongation; next they are in rows; then the ends in contact are without walls, so that each cell opens into its neighbor; and finally, all trace of the separate cell-wall is lost in the straight sides of the nerve tubule, with nothing but the mesoblasts to indicate the original position of the cells. In the chorda dorsalis, intestines, vertebræ, muscles, &c., similar and apparently gradual changes have been observed; but each step, in most instances, was investigated isolately from the previous one, and the intervening space bridged over by the process of inductive reasoning alone. This is not enough; now we know that every second of the life of a cell, or series of cells, may be traced most minutely, minute by minute, hour by hour, and day by day. Day and night, watches have been kept by observers in other departments of science, and why may not the naturalist do so? In some cases a very extensive series of changes may be observed in a short time; for instance, in the embryo of the common Bream (*Pomotis vulgaris*), which Professor Wyman has observed to pass from the segmenting of the yolk to hatching in the space of about forty hours. It is not possible, in any way, to trace the gradual metamorphoses of cells and organs, except upon the living body; otherwise, every observation is a record of a detached fact, and no more; every bit of an organ is subjected to all sorts of manipulations to bring out what too often is not there according to the laws of the living being. Reagents at one time, and pressure at another, reveal, not the truths of nature, but our carelessness and presumption. I have in mind a remarkable instance of the evils of the almost monomaniacal habit of using pressure whilst investigating tissues. A celebrated physiologist, in all probability, missed the most fortunate chance of discovering the key to the whole history of the mode of origin of the embryo from the yolk-cells, simply by using a bit of thin glass to cover the object on his glass slide. Just before the segmentation of the yolk, the full-grown yolk-cells of birds, turtles, if not all scaly reptiles, and sharks, are very thin-walled, hyaline, globular vesicles, each one of which contains a more or less darkened mesoblast, and within the latter are a certain number of entoblasts (nucleoli). Now under the least pressure, the cell-wall bursts quickly, and the mesoblast becomes fissured or wrinkled. In this condition the mesoblast was figured and described as the yolk-cell proper, by no less careful an observer than Johannes Müller. Now in the turtle, at least, the mesoblast undergoes self-division until there are innumerable mesoblasts in the parent cells; and after the latter have congregated to form the different layers of the incipient organs of the embryo, and burst, the former unite side by side, and thus become the original cells of the young tissues.

"I feel that I cannot urge too strongly the utmost necessity of studying living beings as nearly in a state of nature as is possible; to attempt this by all available means and contrivances, and, above all, patiently, not begrudging the time, because more numerous observations might be obtained by making a piecemeal and hurried show of dismembered Nature.

"It would certainly be more profitable, as far as living beings are concerned, if the whole world of science should, for a while at least, investigate exclusively the few transparent animals that may be obtained, than work over the numberless opaque ones which require the dissecting-knife. The first having been investigated, the knowledge of them would assist us the better to interpret the features and relations of the tissues, which we would be obliged to study in a disconnected state, just as fossils are recognized and restored by the comparative anatomist after a careful research among living models.

"I have been anxious to present this communication, and to have it recorded, because certain microscopists, who are considered as high authority both in England and in this country, have attempted to depreciate the value of the flat field and wide angle of aperture in the study of living objects. This is a little remarkable, since it comes from a country where, until recently, the most finished microscopes of this kind were made, and where they are now to be found in large numbers. I will read a few passages, which may be found on page 196 of Dr. Carpenter's work on the microscope. He says: 'The author feels it the more important that he should express himself clearly and strongly on this subject, as there is a great tendency at present, both among amateur microscopists and among opticians, to look at the attainment of that "resolving power" which is given by angular aperture, as the one thing needful; those other attributes which are of far more importance in almost every kind of scientific investigation, being comparatively little thought of; and he therefore ventures here to repeat the remarks he made upon this subject, in his recent Presidential Address to the Microscopical Society, of the correctness of which he has been since assured, by the approval of many of those who have most successfully employed the microscope in physiological investigations: "The superiority in resolving power possessed by object-glasses of large angular aperture, is obtained at the expense of other advantages. For even granting that there is no sacrifice of that most important element, *defining* power (which can only be secured, with a very wide angle, by the utmost perfection in all the corrections), yet the adequate performance of such a lens can only be secured by the greatest exactness in the adjustments. Only that portion of the object which is *precisely* in focus can be seen with an approach to distinctness, everything that is in the least degree out of it being imbedded (so to speak) in a thick fog; it is requisite, too, that the adjustment for the thickness of the glass that covers the object, should exactly neutralize the effect of its refraction; and the arrangement of the mirror and condenser must be such as to give to the object the best possible illumination. If there be any failure in these conditions, the performance of a lens of very wide angular aperture is *very much inferior* to that of a lens of moderate aperture; and, except in very experienced hands, this is likely to be generally the case. Now to the working microscopist, unless he be studying the particular classes of objects which expressly require this condition, it is a source of great inconvenience and loss of time to be obliged to be continually making these adjustments; and a lens, which, when adjusted for a thickness of glass of $\frac{1}{100}''$, will perform without much sensible deterioration with a thickness either of $\frac{1}{80}''$ or of $\frac{1}{120}''$, is practically the best for all ordinary purposes. Moreover, a lens of moderate aperture has this very great advantage, that the parts of the object which are less perfectly in focus can be much better seen; and therefore that the relation of that which is most distinctly discerned, to all the rest of the object, is rendered far more apparent. Let me remind you, further, that almost all the great achievements of microscopic research have been made by the instrumentality of such objectives as I am recommending. There can be no question about the large proportion of the results which Continental microscopists may claim, in nearly all departments of minute anatomical, physiological, botanical, or zoölogical investigations, since the introduction of this invaluable auxiliary; and it is well known that the great majority of their instruments are of extremely simple construction, and that their objectives are generally of very moderate angular aperture. Moreover, if we look at the date of some of the principal contributions which this country has furnished to the common stock, — such as the 'Odontography' of Professor Owen, the 'Researches into the Structure of Shell' carried out by Mr. Bowerbank and myself, the 'Physiological Anatomy' of Messrs. Todd and Bowman, the first volume of the 'Histological Catalogue' by Professor Quekett, and the 'British Desmideæ' of Mr. Ralfs, — we find sure reason to conclude that these researches *must* have been made with the instrumentality of lenses, which would in the present day be regarded as of very limited capacity. — I hope that, in these remarks, I shall not be understood as in any way desirous to damp the zeal of those who are applying themselves to the perfectionizing of achromatic objectives. I regard it as a fortunate thing for the progress of science, that there are individuals whose tastes lead them to the adoption of this pursuit; who stimulate our instrument-makers to go on from one range to another, until they have conquered the difficulties which previously baffled them; and then apply themselves to find out some new tests, which shall offer a fresh difficulty to be overcome. But it is not the *only*, nor can I regard it as the *chief* work of the microscope, to resolve the markings upon the Diatomaceæ, or tests of the like difficulty; and although I *should* consider this as the highest object of ambition to our makers, if the performances of such lenses with test-objects were any fair measure of their general utility, yet as I think that I have demonstrated that the very conditions of their construction render them inferior in this respect for the purposes of ordinary microscopic research, I would much rather hold out the reward of high appreciation (*we* have no other to give) to him who should produce the *best working microscope*, adapted to all ordinary requirements, *at the lowest cost*."'

"Notwithstanding the approval of those, as Dr. Carpenter says, 'who have most successfully employed the microscope in physiological investigations,' I do not hesitate for a moment to declare, that nothing could be more pernicious to the best interests of science than these remarks. It is unfortunate that such mistaken views should be displayed on this subject, where so great confidence has been placed, — by one, too, whose elementary works on physiology have raised the belief, among many, that he is perfectly conversant with those very tissues which require the nicest and most rigid microscopical investigation.

"The illustrations which I have given, of the great value of highly corrected lenses in the study of minute structures, are sufficient, I think, to refute these views; but I would like to say a few words more in conclusion, especially in reference to the general relations of microscopical investigations to other departments of natural history.

"To say that objectives with a wide angle of aperture and a flat field, are needed for only a few bodies, such as test objects, like the Diatomaceæ and other known difficult subjects, is to ignore the whole great department of histology, and by that to refuse physiology one of the most important aids; in fact, an aid which, with the help of better microscopes, in future, is likely to take the lead in the determination of the laws of animal and vegetable life. I am well aware that the study of histology has been pursued with the ordinary instruments, of the German pattern, in a great measure; but knowing what these have done both in Europe and in this country, and having discovered, by a few glimpses, how much more, and how much better, we might have done, had we possessed one of these highly finished instruments, I can confidently assert, that it is a grave error to tell opticians that they had better devote themselves more particularly to the improvement of the ordinary instruments, and let their transcendental corrections of widely gaping objectives serve in the mean while as playthings for curious amateurs.

"But it is a still more serious mistake to say to students, that an instrument which performs under a variety of circumstances 'without much sensible deterioration' is practically the best for all ordinary purposes.

"So thought Ehrenberg, and yet we all now know what curious mistakes he made. Embryology, too, comes under this proscription; for any one who has attempted to trace the development of animals, especially the lower forms of life, must know that it is impossible to separate the study of their cellular structure from the investigation of their organs.

"I cannot more fittingly conclude this communication, than by quoting, by Mr. Spencer's leave, a portion of a recent letter of his to me. He says: 'It seems to me that there is every reason to hope much from the earnest application of high powers with large angles. So blind and inveterate has been the prejudice in favor of low powers and small angles, in histology, that younger and less prejudiced microscopists have a comparatively untrodden path before them. Every day's thought convinces me more and more deeply of the radical mistake that has been made in this direction. I have recently been making some observations and experiments with low angles on certain well-known structures, and have in several instances been struck with a blank astonishment at the utterly false, though apparently reliable, results obtained. It happens, too, that the physical and optical characters of those tissues which, oftener than any others, are the subjects of your study, are precisely such as will lead to the most frequent errors; and if you do not find that many a blunder has been made in their study, heretofore, I shall be greatly surprised.'"

Four hundred and sixtieth meeting.

February 8, 1859. — ADJOURNED STATED MEETING.

The Academy met at the house of Hon. Josiah Quincy.

The PRESIDENT in the chair.

The Corresponding Secretary read the following letters, viz.: from Der Kongelige Danske Videnskabernes Selskab, Copenhagen, July 1, 1858; K. K. Geologische Reichsanstalt, Vienna, November 30, 1857; and the Zoölogisch-Botanischer Verein, Vienna, March 15, 1858, acknowledging the receipt of the publications of the Academy; — from Der Kongelige Danske Videnskabernes Selskab, July 1, 1858; Société Imperiale des Naturalistes de Moscou, June 17, 1858; Die Königlich Sächsische Gesellschaft der Wissenschaften, Leipzig, April 28 and July 18, 1858; and Die K. K. Geologische Reichsanstalt, Vienna, January 10, 1857, presenting their various publications.

The recent decease of a distinguished Fellow, William H. Prescott, the historian, was noticed in the following remarks.

Rev. George E. Ellis said: —

"I rise, Mr. President, at your request, to engage the attention of the Academy for a few moments in one of those sad but grateful offices of respectful commemoration, which something better than mere usage exacts of the living, when they miss from their pleasant fellowship an honored associate. The late Mr. William Hickling Prescott was a

Fellow of this Academy. His election to it was among the very first of that long succession of honors which the scholarly and scientific associations of both hemispheres bestowed upon him; feeling that they needed the lustre of his sure fame, as much as he needed the patronage of their applause. When I look around me now upon this circle of gentlemen who represent so much of the higher intellectual culture of our time, in all departments of thought, research, and genius, and when my eye falls upon more than one who by age and intimacy has claims far beyond my own to introduce this memorial tribute, I cannot but shrink from what I have assented to undertake. But some grateful motions for many, very many favors and kindnesses from our departed friend, encourage me. They even constrain me. There is a relief for sad feelings in the expression of grateful feelings, when they lie side by side in the heart as engaged toward the same object. If, by speaking my few sincere words in this presence, I can pay something of my debt to the dead, I will do so.

"But one day more than a week has passed since — amid an assembly composed of such as no other occasion would have grouped together, and moved as by the sympathy of a very deep sorrow — we saw all that was mortal of that cherished and eminent man, resting for a few moments before the Christian altar where he had been wont to worship. And then some of us saw the casket of the clay deposited in the last repose, beside the dust of those revered parents who had remained with him in life long enough to know his fame, and had gone before him not so long as to be widely severed in the spaces of higher life. Some of us associated here in the interests of the broadest range of literature, science, and art, have already, in a circle more restricted in its object, as devoted to his own special pursuit of history, united in a tribute to the character and the splendid achievements of Mr. Prescott.* Nor will those of us who thought, and felt, and listened there, soon forget the spell from the tongues that spoke then the promptings of touched hearts. A rare but most fitting succession of utterances! His nearest friend in the confidence of daily intercourse, and the most competent of all witnesses as to matters of scholarship in Spanish literature; next, the best known and the longest in service of our American historians; next, the reverend President of the College, as his classmate; then one who had

* The Massachusetts Historical Society.

been his religious teacher and continued his attached friend; and next his companion in foreign travel in the bright days of their early manhood; and then the emphatic tribute, without the frost and with all the tenderness of age, offered by the Nestor of that Society, our host now, — the venerated friend of the departed, and his father's friend. These were enough; but there were more, truthful and ardent tributes. But the feeling stirred by such a loss to us, here, and there, and in how many other places and fellowships, does not expire by its expression in warm eulogistic utterances. And these are but the beginnings of a series of memorials, which will need more than the months of this passing year for the gathering them into the wealth of posthumous honors.

"That long list of academic distinctions attached to Mr. Prescott's name in the triennial Catalogue of Harvard, may represent the order in which the most eminent of the scholarly confraternities of the civilized world will learn of the bereavement which is so recent to us, and will hasten to express, record, and transmit to a sad home, their successive tributes. To them, for the most part, he is known only through his works, and the report of his character as a man. To us, the familiarity of those pleasant and winning features, of those gracious and refined manners, of that courteous speech, and of those delightful hospitalities, where he was so cordial, so attractive, so radiant, adds a charm that plays over his pages, and makes real a sorrow such as strangers, remote and distant, will not know.

"And what is the significance of these associated tributes, which such fellowships of lettered and scientific men are prompted to render, first, to the talents, and then, when truth allows, to the character, of their more distinguished members? If it were merely in friendship, through private relationships of intercourse and esteem, or in sympathy with the bereaved, it would be wiser to reserve speech. Those to whom it was addressed might not be in the mood to hear it. But over the departure from life of one who was eminent in the gifts of mind, and who devoted them all, for the working period of a whole life, to the service of the world, to instruct, to refine, and please, to extend the ennobling sway of intellect in the toils of truth, — such personal tributes have a warrant which needs no pleading to assure them. The only cautionary suggestion to be remembered is, that we respect the most severe rules of good taste in avoiding all exaggeration and flattery, and that we think so exclusively of him that is gone, as to have no thought of borrowing honor for ourselves or our association from his own worth. Mr. Prescott's fame has already gone, on its own wings, to wider reaches and recesses in distance and space, than any tribute from any association is likely to reach.

"He has done honorable and signal service to the world's literature, and especially to American literature. We cannot overestimate the value of his service here. All that we can call our national literature, leaving out of view works of merely local interest, has been gathered during the years of Mr. Prescott's life, which was not a long one. With the exception of the works of Franklin and Jonathan Edwards, every book of American origin which foreigners would care much to read, falls within this century. When the time came for us to begin, it was well that we had master-builders to lay the foundations. Such a one was Mr. Prescott. His many volumes — so faithfully wrought from materials of prime value, gathered from wide research, at great cost, sought at an opportune time, and furnished through rare impulses of zeal and friendship by men in public and private stations all over the world, so happy to serve such a cause in such hands — are a noble monument to his genius, to his industry, and to his systematic, persevering, and enthusiastic devotion of time, heart, and life, under some severe and depressing difficulties. We must not, however, exaggerate those difficulties, nor forget his rare privileges. He himself occasionally expressed regret, that where his works were best appreciated in foreign journals, and in some quite near his home, he was represented as wholly sightless, and as a hopeless, though very patient, invalid. There was a sickly odor even in the praise which so overstated his weakness of vision. He had rich and rare opportunities and facilities for the work which he achieved. His true heart estimated them highly, and so must we. They will not overshadow their results. He had a finely organized nature, a placid temper, a home and parentage of the most kindly and fostering and quickening spirit in all its sweet influences of gentleness and culture. His father was very wise, and very good. His mother was all that, and saintly too. He had resources from which to draw adequate means for every want. He had leisure time to fill, an unprofessional life to occupy, and a just ambition to crown with some fit end in existence. To him much was given. There was a peculiar refinement and tenderness in his make, not womanly either, but still manly, — a delicate grace of style and manner, which, when we see it in the favored few of our race endowed to finer uses, half persuades us that, after all, there is a choice vein even in the mortal clay which the elemental chemistry of the Creator works up for the tabernacles of selecter human spirits. It was through this beautiful nature that he won friends of all who approached him, and kept all that he had won.

"With all these means and felicities, he was rightly held to accomplish some high service. An impaired vision turned for help to others' eyes, and a frame not robust was spared the over-task, and was kindly watched and exercised. Conscientiously truthful as a writer, he felt the responsibility of stamping fair paper with records and judgments about the dead, which would convey enduring impressions to the living. He enjoyed the romance of his themes, and he intended so to deal with them that his readers would be held closely to his narrative. In this intent he succeeded. It was somewhat noticeable, that on the very day of his obsequies, a few hours before the bookstores were to be closed in sympathy with the sad service in the church, there was circulated among them a prospectus and specimen sheet of a new and rival work on the Conquest of Mexico. I saw the pamphlet, but did not feel disposed then to open or to touch it. I have since read it, and find that its claim is to a severer authenticity of narrative than is allowed to Mr. Prescott's work, which is charged with an excessive confidence in monkish, legendary, and unreliable authorities. Mr. Prescott was well aware that this criticism had been visited upon his History on its first publication. The charge, however, is hardly warranted to the extent to which it is pressed. The careful reader of his work will find many cautionary and abating criticisms in his notes on these disputed authorities. But this is no time or occasion for pursuing such suggestions. I wish only to add, that the promised work has lost the most interested and candid reader that it would have had, in Mr. Prescott.

"Since he has left us, with the feeling natural at such a time, I have been reading over, in a quiet hour, every personal memorial which I have of him in note and letter. It is pleasant to find in them a series of communications running parallel with his whole course as an author, and with a score of years of most agreeable intercourse. His first work, Ferdinand and Isabella, his gage to fame, was published just as I was preparing to leave my home, a stone's throw from his own, for foreign travel. He asked me to assume the pleasant office of convey-ing copies of the book to some distinguished literary men abroad, and of making researches for materials for his next projected work. Who ever failed to serve himself in serving Mr. Prescott? I find by one of his letters, dated exactly twenty years ago, that he thanks me for seeking in Rome to engage that accomplished scholar, the Marquis Capponi, to undertake an Italian translation of his work, and that he manifests an intense ardor in the pursuit of his favorite studies.

"That projected work he completed, and others too; and yet another, in its midway course, he has left. But our regret for his arrested labor on a great theme must not reflect back on his own life, as if that, too, were incomplete, except as the exquisitely polished shaft lifted on its base is incomplete till it receives its acanthus wreath. Every human life is incomplete; and the noblest, the most useful, the best devoted lives are the least complete, because the highest purpose of them is the least finished in its result. But neither to reason nor to faith is there a surer testimony to a life up and yonder, than an incomplete earthly life when it has been pure and good, devoted, faithful, benedictive to others.

"That library, the larger brain of him who was its grace and glory to our eyes, we shall never enter again without a feeling of dreariness and vacancy. Its fulness will express its emptiness. We shall seem to hear in it the solemn apostrophe, so solemn, with which Sir Walter Raleigh closes his History of the World, beginning, 'O Eloquent, Just, and Mighty Death!' Among those gathered trophies of the world's genius, with the choice gifts and mementos from all lands and many hearts, he lay in death till the earth claimed her own. We believe that Heaven had already had the better share in the spoil, — had claimed the treasure and left the casket. I would offer to the Academy the following resolutions: —

"*Resolved,* That, as Fellows of the American Academy of Arts and Sciences, while we bow in submission to that sovereign decree which has closed the earthly life of our honored and cherished associate, William Hickling Prescott, we would join, with all our hearts deeply and gratefully engaged in the tribute, in bearing our testimony alike to the winning manners, the pure, unsullied life, the fine genius, the distinguished attainments, and the noble works in one of the highest departments of literature, which won to him such honors and such fame, at home and abroad, during his allotted time of existence.

"*Resolved*, That we regard his contributions to historical science as reflecting the highest honor on this city of his residence, and on the country which fostered and appreciated his genius; and that every recognition of the merits of those works, and of their author, from abroad, is to us a renewed token of the true sympathy and union which all liberal culture and all liberal studies will establish between the nations of the earth.

"*Resolved*, That a copy of these Resolutions, signed by the President and the Secretary of the Academy, be transmitted to the family of our late associate, with the expression of our profoundest sympathy in their severe bereavement, measured only by the exalted regard, the personal respect, and the fraternal esteem which we cherished in life for him whom we now mourn."

The resolutions were seconded by Mr. Charles G. Loring, as follows: —

"Mr. President, — It might perhaps seem enough simply to second the motion now proposed, and to leave the adoption of the resolutions to the spontaneous emotions with which the heart of every lover of science, literature, and art, and of the beautiful and noble in character and life, is filled in contemplating the death of William H. Prescott.

"But as one whose acquaintance with him began in the school-room, and has continued for more than forty years in an association of the most unreserved and familiar friendship, every member of which feels, in his death, the sharp pang as of a domestic bereavement, I may ask indulgence to pay a humble, simple tribute to his memory, though it be only a pebble added to the monument which the world is raising upon his grave.

"Of the lustre of his genius and achievements, and of the glory he has shed upon his name and country, no one need now speak; for the whole civilized world is familiar with them, and brighter and happier in the consciousness of them. And least of all should I attempt to emulate the tributes paid to them by the many gifted tongues and pens from which such tribute may gracefully proceed.

"But of the claims — and may I not be permitted to say the higher and holier claims? — he had upon our affections while living, and should have upon our fond recollections and reverential regard now that he has left us, I feel privileged to speak, for the domain of the heart belongs equally to all, and my acquaintance with his has been almost life-long.

"The great foundation of his noble and beautiful character, of its loftiness and its humility, of its strength and its loveliness, is to be found in the wonderful equipoise of the mental and moral powers with which he was so signally gifted, constituting, as it were, an atmosphere in which they all had full and equal life and play, — their combined and harmonious action giving a self-possession, for the accomplishment of great results, far superior to physical bravery or nervous excitability, or any capacity for extraordinary effort in great emergencies, — imbuing him with a moral and intellectual consciousness, which needed no summons of occasion to awaken it to action, no studied array of the will against the seductions of passion, pleasure, or ease, and culminating in a courage which, revering and yielding to nothing but the truth, fears nothing and which nothing can subdue, — all bathed in the constant sunlight of a cheerful, genial, and affectionate temperament, perhaps not less peculiar than his genius.

"This peculiarity of mental constitution — among the highest of the gifts of Heaven — seems to have been a blest inheritance from a truly noble ancestry; evinced alike by his heroic grandfather, who retired from the most glorious battle-field in the history of his country, where he had imperishably interwoven his name with the achievement of her independence, as seemingly unconscious of any unusual effort, or of any personal meritorious achievement, as if resting from any ordinary toil of daily duty; and by his no less honored father, whose life was an illustration of simple devotion to its highest duties, as unconscious of the reverential affection and respect which everywhere surrounded him, as he was unambitious of the public honors with which his fellow-citizens would gladly have invested him.

"And here we have, as I think, the solution of our friend's successful struggle against physical infirmity, and of his brilliant victory over one of the most embarrassing and depressing privations which could befall the student or aspirant for literary eminence, and particularly in the department which he had selected; and which privation has given such touching interest to his works.

"Others, like him, have encountered the same calamity, — and with equal resolution have not suffered it to impede their path; some under the stimulus of necessity which admitted of no halting; others to gain an otherwise inaccessible social position for themselves or families; and others by an overleaping ambition, knowing no rest and faltering at no obstruction. But he whom we mourn was urged on by no such incitement. The position and wealth of his family secured to him, without effort on his part, all he could desire of rank or competency in social life; and he had none of the restless craving for distinction, or for surpassing others, too often the sole incentive of vulgar ambition: nor was he pressed by the solicitations or flatteries of friends to seek for himself a name among the eminent of the earth.

"But his noble struggle and glorious victory over the embarrassments which environed him in the outset of his career, and which to many would have seemed insurmountable, resulted from the natural and unstrained workings of a self-poised mind, conscious of its powers and duties; loving, for their own sakes, the play of its mental and moral faculties, and the truths to which it led; and looking upon the obstacles in his path only as suggesting the means of overcoming them.

"And here, too, we may find an explanation of the remarkable equanimity and simplicity evinced amid the world-wide honor and adulation showered upon him at home and abroad. They are attributable to no studied effort of self-control, and no premeditated discipline of mind or heart, but were the natural result of this never-failing moral self-possession, raising him above them. These honors had not been the moving object of his efforts, nor the rewards he had been seeking, great and precious as they may be justly esteemed. The compensation he had sought for was found in the joyous exercise of his faculties, and the gratifying results to which it led in his own mind and heart. These outward manifestations of his success were but the adventitious circumstances attending those results. He was not, nor indeed could he have been, unmindful of them, or of the just gratifications to be derived from them; nor did he affect to disregard or undervalue them. He was modestly conscious of his honors, and enjoyed them in communion with his friends, but most simply and unassumingly.

"The character and manners of Mr. Prescott were distinguished by a manly, prompt, and universal benevolence, — never checked nor chilled, but pleasurably excited by the success of others; and never yielding to any gratification in their failures or errors, but throwing over all the mantle of loving-kindness and charitable construction.

"His wit was indeed ever ready and inexhaustible, and he was keenly perceptive of the ridiculous in every form. But his playful raillery was never tinged with any unkindness, — more often turning upon himself than upon others, or reaching others only through himself; while producing often uncontrollable merriment, it ever ended in increased love and admiration of the genuine simplicity and nobleness of his nature.

"It would be to me, Mr. President, a delightful theme to dwell further upon the noble and beautiful elements composing the character of our friend, — the remembrance of which, to those who knew him intimately, is far more precious than that of his literary renown, great and world-wide as that is; — to delineate that marvellous combination of manly strength with feminine delicacy and child-like simplicity; that ever sensitive conscientiousness regarding his own duty, united with such gentle charity for others; that instinctive love of truth, combined with such brilliant imagination, by whose light it was ever so beautifully illustrated, but never distorted; that wit and habitual merriness, so exquisite and yet so harmless; and that loyalty to friendship and affection, in the fond remembrance of which so many hearts are bleeding. But I must forbear, and leave the theme to a fitter place and abler hands.

"I have, therefore, only to add, that, in seconding the motion for the adoption of the resolutions, I do it in the conviction that the Academy has never lost a member more worthy of an honored memorial upon its records."

The resolutions were also supported by Professor Theophilus Parsons, as follows: —

"When you intimated to me, Mr. President, your wish that I should say a few words on the topic which will occupy us this evening, it was difficult to assent, but impossible to refuse. I know not in what words to speak of Prescott. He was my oldest friend, — the last friend of my boyhood. Our fathers were intimate friends, and their intimacy fell to us as an inheritance. His genial face, and that cordial manner, which was but the transparent vesture of his constant kindness, I shall meet no more. But this is not the place to speak of my personal relations to him. Nor need I add my testimony to the universal recognition of the ability, the industry, the accurate learning, the admirable judgment, and the perfect taste, which have placed him at the head of our literature, and made him our pride.

"There was, however, one peculiarity in his character which I have studied carefully, and have not as yet seen fully noticed by any of the many who have spoken of him; and I should be glad to say a few words in relation to it. I refer to the blending in him of qualities which are usually regarded, not only as opposites, but as antagonists, and as mutually destructive.

"On the one hand, he was by nature soft, tender, and impressible. I never knew a person who had so much capacity for enjoyment; and I never knew one who had a greater love for it. And this was universal. It seemed as if he were alive to all the emotions, and possessed all the sensibilities, which are divided among other men, and in their division constitute the means of happiness for each. And I will add, that he was naturally as susceptible as any one could be, of every curled rose-leaf which threatened to mar his enjoyment.

"But, on the other hand, this man had an iron will; before his invincible energy, obstacles which to others would have seemed, and would have been, insurmountable, melted away. By his strength of purpose, obstructions were converted into helps. He had a resolute and unflinching self-control and self-restraint, and an unfailing power of self-government, upon which he knew that he could depend, and on which he did depend, always advancing, never losing a step that he had gained, and never doubting that he should gain the next, until, at length, he stood upon the eminence which from the beginning had been his goal, and upon which death found him.

"It has seemed to me that these qualities concealed each other, even from those who knew him. They who were most assured that he had won his high position by a stern devotion to his own lofty aims, and by unexampled force of character, sometimes imagined that such a man could not be sincere in his ready sympathy with all, in his full enjoyment of common pleasures, in the cordiality with which he came forth to meet all who approached him, in the smile which made all who saw it believe that he was happiest when he could make others happy; and it seemed to them as if this must be only a thin varnish, a mask of courtesy, which his knowledge of the world taught him to wear.

"Nothing, nothing could be more untrue. Believe me, Mr. President, when I say that an experience of more than fifty years justifies my assertion, that it was out of the abundance of his full and overflowing heart that his mouth spake his many words of kindness. And they who were certain of this, — who saw him day after day, entering with as ready gladness into all social pleasures as if he were the merest idler, and giving himself up to the enjoyment of the hour as if he had no other use for his time but to give it wings, — they found it difficult to believe that there was not something of unreality in his world-wide fame; or that something of accident had not helped him in his extraordinary career; or that his unconquerable will had fairly paid for his great success the full price of severe labor, of effort, and of sacrifice. As difficult as it might be for one who looks on a mountain clothed with beauty and fruitfulness from its foot to its summit, — whose flowers breathe fragrance and whose foliage bends to the summer wind, — to remember while he looks, that its framework and substance are of the everlasting granite that bids defiance to accident and to the assault of the tempest.

"Prescott will ever give a valuable lesson to all who knew him, and to all who, without knowing him, form a just idea of him, — and they must be many, for surely History will long love to speak of him, — and this lesson will be, that all of a man's nature may be cultivated and exercised and indulged and enjoyed, if only all its qualities are duly arranged and subordinated. These two elements of character of which I have spoken did not merely co-exist in him, but co-operated. If either had been absent, or either had been less, he never would have done all that he has done. Every one admits, that, without his unyielding energy and his invincible endurance, he could not have accomplished his great works, in defiance of the great obstacles which cumbered his path. I am quite as sure, that even this energy and this endurance would have failed and fainted, if they had not been constantly invigorated, and refreshed, and filled with new life, by his exquisite sensibility to all innocent enjoyment.

"Let no one who would pluck a leaf of laurel from the topmost bough, imagine that he must nurse his strength for this achievement by the sacrifice and suppression of whatever in him is sympathetic and sensitive and responsive to others. Let Prescott tell him how all the gifts of a rich nature may be kept in full life, and may invigorate each other. Let Prescott remind him that there was a laborious student, whose hours of toil nothing was prmitted to interrupt, and whose determined industry nothing was permitted to abate, and yet whose companionship was sought as no other man's was; because, when the hour for labor had passed, he went forth among his friends like sunshine, and filled them with sympathetic gladness from his own joyous nature.

"We sometimes hear it said that a man has succeeded in some great effort because he put his whole soul into it. This would be true of Prescott in its ordinary meaning, which is only that he succeeded by enthusiastic labor. But it is true of him in a more definite, and, as I think, in a higher sense. If I were asked to give in the fewest words the explanation of his career, I should say that he did great things in despite of great difficulties, because he was richly endowed with many and various qualities and faculties, and in all his work the whole man worked together, with a harmony which gave to every faculty the support and the strength of all the rest."

Mr. Charles Folsom also noticed the decease of Mr. Prescott, as follows: —

"Mr. President, — After what has been so eloquently and fittingly said of the talents and virtues of Mr. Prescott in various other relations, I cannot refrain from bearing my personal testimony, (for which I may not have another opportunity,) as to their habitual exercise in the details of his literary life, his life as a working scholar.

"It is now about forty-seven years since I was a spectator, at Cambridge, of the calamitous accident which consigned him for many months to a darkened room, with the entire loss of one eye and a permanent injury of the other; — a dispensation of Providence, which, 'depriving him of sight,' (it may be said, I believe, as truly in his case as in any other,) 'gave him song.' From that painful hour my interest in him began. Years of distant separation soon followed; but when I next met him, it was to be admitted to his close friendship, after the purpose of his life was fixed and he had already put on that bright harness for intellectual achievements, which he wore to the last. From that time, Sir, I had the privilege to be cognizant (few were more intimately so) of the inception, the progress, and the glorious completion of all his published writings, from his essays — his prelusive attempts — in the North American Review, down to the volume which is the most precious as his last.

"Of the 'calamities of authors' he knew nothing from experience;

but no writer for the public can be exempt from the vexations of authorship. The testimony I would now bear to our deceased friend is this; — that, amidst all the petty trials which to so many authors make life one continued agony, or constant solicitude, he ever kept his serenity, his superiority to his work; — that, though self-relying, because conscious of his high faculties and of the scrupulous fidelity he had used in seeking for the truth, he yet welcomed the contradiction of friends while it could aid him in reviewing his own judgments (always his own) whether as to fact or to expression. In such cases he was so intent upon accuracy in fact and fitness in art, that his self-love never was wounded by the sharpest criticism, right or wrong. It was a personal matter, not with him, but with Truth, whom he served. If wrong, it glanced off; if right, he laid it upon her altar. The self-discipline which this implies in one so sensitive to literary applause, so justified (if any one could be) in intellectual pride, can belong only to noble natures; and its exercise is a test of true magnanimity.

"Endowed with the imagination and fancy of a poet, he felt his danger as an historian; and he restrained his fancy with a giant's grasp. Proportion, congruity, what sacrifices do they not require of a mind so exuberant! The ingenious thoughts, the brilliant images, the felicitous phrases, which were discarded, — how great was the sum of them! The rejected stones were of the same material as the edifice in its finished beauty. When he had established the facts relating to his theme by the most laborious study, perhaps for years, and his mind was full-fraught with materials, arranged in logical order, then 'he mused, and the fire burned.' Then came the bounding play of his finer faculties. He delighted to throw himself into the characters he had to do with, in their own time and place, and to reason, feel, enjoy, and suffer with them; and this he thought necessary in order to pass a fair judgment on them as human agents, — as they were in themselves, and as influenced by circumstances. He 'suffered' with them, and 'learned mercy.' But he never failed afterward dispassionately to take the judgment-seat. His mind had become eminently judicial, trained in this respect by the most intimate communion with his distinguished father. And if he has not often pronounced formal sentences, — if, of all that was true in any case, he shows a marked propension to what was unquestionably good in it, — he yet believed that somewhere, in his text or his notes, he had left, in every such case, evidence, not to be mistaken, of a moral judgment which would stand the strictest scrutiny.

"With him composition was not necessarily connected with the use of the pen. Such was the power of his disciplined memory, that, even when abroad for exercise, he could go on 'weaving his lay,' and confiding sentence after sentence to the faithful tablet within him. Beneath the hoary willows at Nahant, which bound and overshadow 'Prescott's Walk,' he might be seen, day after day, treading alone for hours the short and well-worn path; and sometimes heard, too, but muttering no 'wayward fancies.' There he marshalled his armies, and fought again battles that had once settled the fate of nations. There gorgeous processions passed in review before him, or tropical scenery clothed the rocks of Nahant. He more than once said to me, that what he considered some of the happiest passages in his works were not only thought out, but mentally fixed in precisely their present language, on that narrow spot. It will hereafter be numbered among the 'remarkable places' associated with the history of remarkable minds.

"But, Sir, I will not anticipate his biographer, or further delay the passage of the Resolutions before you, which I second with my whole heart."

The resolutions were unanimously adopted.

Professor B. Peirce announced to the Academy the decease of the late William Cranch Bond, Director of the Observatory of Harvard University, as follows: —

"Mr. President, — How often is it noticed in the affairs of men that affliction waits upon affliction! It is my sad duty to swell the current of the present sorrow, and draw the attention of the Academy to the loss of another of our most eminent associates, whose far-reaching and well-earned reputation has been reflected back from the older shore of the Atlantic, in one of the distinguished honors so rarely conferred upon those of American birth. William Cranch Bond, the Director of the Observatory of Harvard College, and Phillips Professor of Practical Astronomy, has ascended to the nearer study of the stars, and joined the constellation of the devout astronomers of past ages. I can attempt no elaborate eulogy, but must depend upon those whom Heaven has gifted with diviner powers of utterance to express the emotions to which we are all ready to respond.

"During seventeen years I have been Mr. Bond's colleague in Harvard College, and this interval comprises the whole period in which he had any favorable opportunity of astronomical investigation. But his love for the science had been shown long before he came to Harvard, and even a quarter of a century earlier he made a careful survey of the Greenwich Observatory, at the request of Professor Farrar, with direct reference to the superintendence of the erection of an observatory at Cambridge. This was in the year 1815, at a time when only a small fraction of the present members of this Academy had reached the age of manhood, and while Bowditch was still in Salem, with his great intellect just beginning to dawn upon the learned societies of Europe. When Mr. Bond returned from England, he set up a small observatory of his own, where he undertook the observation of occultations and eclipses. It was here that he developed one of the finest elements of genuine enthusiasm and true genius, that of accomplishing much with small means. In this liberal age, when there is such a generous flow of material aid to the laboratories of science, there may be danger that the ostentatious display of the appliances for discovery will be substituted for the performance. On the contrary, a healthy state of public opinion should demand that the intellectual product be commensurate with the greatness of opportunity, and that the magnitude of donation should be proportionate to the reasonable anticipation of the corresponding increase of knowledge among mankind.

"While Mr. Bond was devoting himself to astronomy with simple and unassuming zeal, he attracted the kind and approving regards of men whose approbation and friendship were worthy of being secured, and who never deserted him. When, in the year 1842, he was drawn to Cambridge by the strong hand of President Quincy; when the cause of the Observatory was undertaken by the unflinching and irresistible vigor of my friend, Mr. J. Ingersoll Bowditch; when even the heavens came to our assistance, and that wonderful comet of 1843, appearing at mid-day in close proximity to the sun, and seeming to send off in a few hours its immense train of two hundred millions of miles in length, excited most opportunely a universal interest in celestial phenomena, — it was then apparent that the affection for Mr. Bond was the chief strength of the occasion, and to that were we mainly indebted for the successful attempt to obtain the unrivalled equatorial of the University, and to lay the foundations of the Observatory. In the history of American science there is no more memorable epoch. An Observatory was finally established, — that natural and almost necessary centre and nucleus of science. The mathematicians must thenceforth concentrate upon it, the physicists must gather upon the geometers, and then the chemists, geologists, physiologists, and the whole sphere of the sciences, must condense and organize around it, by a law as certain as that by which the stone tends to the centre of the earth, as organic as that by which the homogeneous egg grows into a living being, with all its system of vital organs and intricate machinery, and as comprehensive as that by which the nebulæ are condensed, through spirals, rings, and spheroids, into astral and solar systems. The habitations of the other sciences are free to move from place to place, but the temple of astronomy is fixed in its position; with its towers and piers, it stands immovable, and the wise men who would worship in it must seek it beneath the star which stands above it. The observatory is immovable, with its foundations deeply imbedded in the solid earth, but its telescope ever points in that direction where all science must begin and end, — toward God's throne, toward the perpetually moving and infinitely deep ocean of the stars, — and ever raises us nearer and nearer to the lessons which the Creator has written upon the firmament. Is it not, then, the truest type of eternal progress founded upon immutable principle?

"The astronomical researches of Mr. Bond while at the Observatory are so recent, that I need only allude to them. By the habits of his life his attention was especially drawn toward the improvement of the instrumental means of observation. Hence we have from him, and under his administration, — 1st. The ingenious Observing-Chair of the great equatorial; 2d. The Spring-Governor, which, whatever may be the rival claims as to the invention of the admirable telegraphic method of observation, which is replacing all other methods, has even been introduced into the Observatory of Greenwich, and is everywhere known as the American method, is generally admitted to be much the finest contrivance yet invented for the making and preserving of its records, and which has also been recently adopted, with extraordinary success, for the sustenance of a most exquisite form of uniform rotation; and 3d. The application of photography to the sun, moon, and stars.

"In his original investigations, he naturally restrained himself to those forms of observation which were fully within the reach of his own resources. He did not, therefore, seek those inquiries which could only be accomplished by long, intricate, and profound mathematical computations, but preferred those which were merely dependent upon the thorough discipline of the senses. He consequently availed himself less of the remarkable capacity of his instrument for delicate and refined measurements, than of its exquisite optical qualities. But when observations were required which must be passed over to the computer, his skill was not wanting to the occasion. Thus, in conjunction with Major Graham, he made that choice series of observations from which the latitude of the Observatory was determined. His observations, and those made under his administration, upon the nebulæ of Orion and Andromeda; the interesting discoveries as to their revolution and peculiar configuration; the researches into the physical aspects of the different planets, and especially those upon the Saturnian system; and the remarkable discoveries of the larger ring and of the fluid constitution of the ring, and of the eighth satellite, — need only be named. They are known to all; they have passed into the text-books of astronomy, and our children's children will be familiar with the name of Bond.

"Permit me, Sir, to embody my high estimation of Mr. Bond in the following Resolutions: —

"*Resolved*, That, as Fellows of the American Academy of Arts and Sciences, we are grateful for the long and valuable services of William Cranch Bond, who has proved that an American mechanic can accomplish one of the highest positions in science, and whose astronomical discoveries have illustrated his country and his Observatory, and stamped his own name honorably and indelibly upon the records of history.

"*Resolved*, That in the simplicity and sincerity of his Christian life, which, purifying his spiritual atmosphere from all influences which might disturb observation, imparted that serenity and tranquillity which charmed his friends, and was manifest in the modesty, neatness, and integrity of his various communications to the public, he was an example which we grieve to have lost.

"*Resolved*, That a copy of these Resolutions be communicated to his family, with the expression of the profound sympathy of the Academy in their great and sudden bereavement.

"*Resolved*, That copies of these Resolutions be transmitted to the different learned and scientific societies of which Professor Bond was a member."

The resolutions were seconded by Hon. Josiah Quincy, in the following words: —

"I cannot refrain from offering a brief tribute to the memory of William Cranch Bond, with whom my acquaintance began early in this century, and has continued to the present time. His name recalls that of his maternal uncle, Richard Cranch, of whom a transient notice is not out of place. He was one of our number, and was among the early associates of this Academy. As his position indicates, he was one of the distinguished men of his day, — sought, honored, and beloved. His look and countenance are almost identically expressed in the portrait of John Locke, prefixed to the folio edition of his works; and his contemporaries recognized in Mr. Cranch the same searching, liberal, intelligent spirit. The character of Mr. Bond was, I doubt not, influenced by that of this relative. In their talents and temperament there was a marked similarity. Each of them gentle, simple, and unobtrusive in mind and manners, — casting a natural light on the objects of thought and discussion, without seeking or expecting any self-illustration from the reflection of its rays.

"William Cranch Bond was born in Portland, Maine, in 1789. The removal of his parents to Boston, in 1790, gave him the advantage of the common schools for a short time, but pecuniary restrictions obliged him to become an apprentice to his father, 'before,' as he said, 'he had learned the multiplication-table,' in the business of a watchmaker and a regulator of chronometers. To acquire greater accuracy in his employment, he was accustomed to take the altitudes of heavenly bodies in hours stolen from business or sleep, and supplied the want of adequate instruments by inventions of his own. His observations of meridian transits were first made by adjusting sight-vanes to the side of a house, over which he noted the appearance and disappearance of the stars. To improve his sight, he was accustomed to gaze for some time into a deep well before searching the sky for comets and indistinct objects.

"The total eclipse of the sun in 1806 first directed the attention of Mr. Bond to the study of astronomy, at the age of seventeen.

"In 1811 the observations he made on the comet of that year were honorably noticed by Professor Farrar, and published in the third volume of the Memoirs of the American Academy (page 308). This object was detected by him four months before it was seen at Cambridge: not by accident, for at this time he was in the habit of carefully noticing celestial phenomena, but with little assistance from instruments; and his talents and attainments now drew upon him the attention of scientific men in this vicinity, — among others, of Professor Farrar and Dr. Bowditch. By their influence, he received from the Corporation of Harvard College, in 1815, a commission to examine the Observatories and their instruments in Europe. On his return, he constructed the model of a dome, which, in all essential respects, resembled that erected thirty years afterwards at the Cambridge Observatory. The mode now universally adopted for supporting and moving it, is claimed to be his original invention.

"In the autumn of 1839, I learnt that Mr. Bond was engaged under an appointment and contract with the government of the United States, with a well-adapted apparatus, in a series of observations on meteorology, magnetism, and moon culminations, as also on all the eclipses of the sun and moon, and Jupiter's satellites, in connection with those which should be made by the officers of the expedition to the South Sea, commenced under the authority of Congress, for the determination of longitude and for other scientific purposes. I was at that time President of Harvard University, and being satisfied, by inquiry, of the depth and extent of the scientific attainments of Mr. Bond, and of his singular fidelity and exactness as an observer, I proposed to him, before asking the sanction of the Corporation, to transfer his astronomical observations from Dorchester to Cambridge, and to unite his astronomical collections with those the University possessed, and carry them on there, and thus draw the attention of the students and the public more forcibly to astronomical science, and create a general interest in the community on the subject, and perhaps form a *nucleus* for an efficient institution.

"To this end I promised him the rent of a house, that three thousand dollars should be raised by subscription and applied to the erection of a building, which, though humble, should have the name and some of the requisites of an Observatory. I intimated the hope that by these means, aided by his labors, character, and influence, an impression might be made on the public of the wants of the University in this respect, and a desire created to supply them.

"This proposal, so in unison with his pursuits and talents, I expected would be received with pleasure, or at least some expression of satisfaction. But it was far otherwise. In the spirit of that innate modesty which predominated in his character, and apparently cast a shadow over all his excellent qualities and attainments, Mr. Bond hesitated, doubted his qualifications for the position. He said his habits were not adapted to public station; that our combined apparatus would be small, and that something great might be expected; that he preferred independence in obscurity to responsibility in an elevated position. He raised many other objections, which need not here be repeated, as they were overcome; and he ultimately transferred his astronomical collections to Cambridge; three thousand dollars were raised; the Corporation provided him with a suitable house, on which a rotary rotunda was raised, from which students of the University nightly watched falling stars, and astronomical observations began more and more to interest them and the community. The kind and unpretending demeanor of Mr. Bond, united with his recognized attainments, greatly contributed to effect the desired result. It is not too much to say, that the extent of his knowledge, the winning urbanity of his manners, and his exemplary exactness in life, and as an observer, in a great degree effected the attainment of those large means and increased powers, which ultimately raised to its present prosperous state the Observatory over which, through subsequent life, he watched, and which he left at death honored and improved by his labors and genius.

"I have expressed my sense of his worth and of his virtues; it is for others better qualified to analyze and dilate on his scientific acquirements."

Mr. Quincy was followed by Hon. Robert C. Winthrop, who said: —

"I have no purpose, Mr. President, of detaining the Academy, at this late hour of the evening, by adding superfluous words to so full, so just, so appropriate a tribute, as that which has already been paid to the memory of our lamented associate. The privilege of dealing with such a career and character as Mr. Bond's belonged eminently to my accomplished friend, Professor Peirce, and to our venerable host, President Quincy; — and I am entirely conscious how small a claim I have to unite with them in bearing testimony to the peculiar merits of so distinguished a man of science.

"It has happened to me, however, for six or seven years past, to be a member of the Committee, appointed by the Overseers of the University, for visiting the Observatory at Cambridge; and, during three or four of those years, to be the Chairman of that Committee. In this way, I have been brought into frequent connection and consultation with the late Director, and have been one of the authorized witnesses of the manner in which he discharged his responsible and arduous duties.

"I desire, therefore, in a single word, to express my deep sense of his devoted fidelity to the interests of the institution over which he presided; and, especially, of his uniformly kind and obliging attention to every inquiry, recommendation, or suggestion of those who, from year to year, were deputed to examine into its condition.

"His own scientific attainments never rendered him impatient towards those of humbler pretension; still less did they blind him to higher truths than any which telescopes can reveal. I only echo the sentiment of one of the pending resolutions of Professor Peirce in saying, that a pure and beautiful spirit of Christian faith and love seemed to actuate his whole conduct, manifesting itself, calmly but clearly, alike whether he conversed with his fellow-men, or whether he conversed with the stars.

"It is this which would alone make his memory precious to his friends, even were his ingenuity forgotten, his inventions superseded, his science obsolete. It is this which consoles them with the hope, that, though he has now passed out of the field of mortal view, — far, far beyond the range or reach of reflector or refractor, — he may hereafter be seen among those who 'shall shine forth as the sun in the kingdom of their Father.'

"It may be well for us all, Mr. President, not to forget, at a moment when literature and science are mingling their tears over the ashes of two of their most ardent and most successful votaries, that the qualities of both which are now most fondly recalled, are not those alone which peculiarly belonged to them as the historian and the astronomer."

Mr. Charles Folsom next spoke, as follows: —

"Mr. President, — The gentleman who presented the resolutions before you, in his earnest and discriminating tribute to the merits of Mr.

Bond as an astronomer, said that he saw around him so many of his friends and neighbors, that it was hardly necessary to speak of his personal qualities as witnessed by them in private intercourse. To them, indeed, it is not necessary. They anticipate at once all that can be said on this point. But, Sir, Mr. Bond was for so long a time obliged to consecrate whatever of time and health his physical infirmity left at his disposal to the study of the heavens, that his earthly relations were comparatively contracted; and many who have been nigh dwellers have had to regret that they could not, with a true regard for him, seek to be neighbors. I happen to be one of the few persons present who began to know him, in social and domestic life, long before he came to the University; and we know, that, to the last, in his domestic and social relations he manifested the spirit of the heaven of heavens, — there is but one word for it, — love. It was his very nature.

"President Quincy has informed us how the professional astronomer was superinduced on the devoted father of a family. Mr. Bond was also the staff of his own venerable father, to be again, in his turn, blessed during his public scientific career with the support — the co-operation of mind, heart, and hand — of one who has been to him at the same time a son and as a brother. Allusion has been made, Sir, to the beautiful blending of these relations in the case of the deceased friend whom the Academy has just commemorated. The parallel occurred to me when the parties were all living; and I trust that the mention of it now is not out of keeping in a meeting like this. I heartily second the resolutions."

The resolutions were then unanimously adopted.

Four hundred and sixty-first meeting.

February 22, 1859. — SUPPLEMENTARY MEETING.

The PRESIDENT in the chair.

Professor Gray resumed the subject of his communication to the meeting on January 11, upon the distribution of plants in the northern temperate zone, and especially in North America and Eastern Asia, and undertook to indicate some of the vicissitudes to which our extant vegetation must have been exposed in earlier times, and which must have influenced the geographical distribution of the species.

He remarked that, for obvious reasons, the remains of plants are not so likely to be found in recent terrestrial formations, as the bones of animals; but when they do occur, they furnish most important data. Researches into vegetable fossils of the tertiary and quaternary formations have recently been commenced in this country by Mr. Leo Lesquereux, who has already shown, in the very beginning of these investigations, that some of our species of plants were in existence anterior to the drift or glacial epoch, and even in the later tertiary period. For instance, in the chalky banks of the Mississippi River, near Columbus, Kentucky, regarded by Mr. Lesquereux as anterior to the drift, this accurate botanist had identified fossilized leaves of our Live-Oak, Honey-Locust, Pecan, Planer-tree, Chinquapin Chestnut, and *Prinos lucidus*, besides those of an Elm and of a *Ceanothus*, which were only doubtfully referable to existing species. The position of the strata bearing these fossil leaves had been indicated by Professor D. D. Owen "as about one hundred and twenty feet lower than the ferrugineous sand in which the bones of the *Megalonyx Jeffersonii* were found"; so that if not anterior, they must have been immediately subsequent to the glacial period; — most likely the latter, since all the vegetable remains of this deposit, which were in a determinable condition, were either positively or probably referred to existing species of the North American flora, although most of them now inhabited a region a few degrees farther south. Again, in a deposit, certainly older than the drift, near Somerville, Tennessee, which Mr. Lesquereux regarded as belonging to the lower or middle pliocene, among fossil leaves all apparently referable to genera of the present flora, two fifths of the species were identified by Mr. Lesquereux with existing species; those of which the identification was undoubted, viz. *Persea Carolinensis*, *Prunus Caroliniana*, and *Quercus myrtifolia*, now belonging to the warm sea-coast and islands of the Southern States.

Professor Gray remarked that this coincided with other evidence, which conspired to render it in the highest degree probable, as he thought, that at least a considerable portion of our temperate flora was in existence in the early post-tertiary, and even in the later tertiary times. Also, that this early temperate flora then rangėd much farther north than now. This he thought clear, both from the species identified in these deposits, and especially from the character of the land animals which in those days roamed over the plains of the Nebraska, consisting of Camels, Horses, an Elephant, a Mastodon, a Rhinoceros, &c.; these herbivorous animals most probably feeding in great part upon herbage like that of the present period, since herbaceous plants and grasses are likely to be more ancient than trees. And, since these animals must have had a truly warm-temperate climate, Professor Gray would positively infer that, in lat. 40° – 43°, they were not living anywhere near the northern limit of the temperate flora; so that the temperate flora, which now crosses the sixtieth parallel in Western Europe, must have then extended to at least as high latitudes in Western North America; and this would make the temperate floras of North America and of Northeastern Asia essentially conterminous, and therefore commingle a certain number of species.

Subsequently, the glacial epoch, coming slowly on, did not destroy the species, or at least did not destroy those species which Mr. Lesquereux has identified with existing ones, so that the same may be inferred of similar species. Those which did survive through a period which brought an arctic climate down to the northern part of the Southern United States, it appeared certain to Professor Gray, must have been pushed on still farther south, and between them and the ice there must have been a band of cold-temperate and of arctic vegetation, perhaps as broad as that now interposed between Live-Oaks, Chinquapin Chestnuts, or Pecan-trees, and the present ice. The existence at that period of an arctic flora, of species identical with the present, was demonstrated by the arctic species which, retreating up our mountains as the climate gradually grew milder, still exist scantily upon the highest peaks of the Alleghanies, and in greater numbers upon the cooler mountain-summits of New England and New York.

As the ice receded northward at the close of the glacial period, the temperate flora would naturally follow it; and Professor Gray insisted, as a most important point in the present discussion, that the temperate vegetation must have again advanced, after the glacial epoch, much farther north, and especially northwest, than it now does; so far north, indeed, that the temperate floras of North America and of Eastern Asia — before conterminous, and then most widely separated — must have again become conterminous. However it may have been in the ante-glacial period, — although it appears certain that some, and probable that many, of our species of plants then existed, — Professor Gray thought it could not be doubted that most of our present species were in existence immediately after the glacial period, and therefore liable to interchange with Eastern Asia at a time when the temperate floras of the two regions were contiguous.

The evidence of such contiguity during what Professor Dana terms the *fluvial epoch*, which succeeded the glacial, Professor Gray remarked, was that a milder climate than the present then supervened, — perhaps not so much higher in the mean temperature of the year at the North, as more equable, — a more oceanic climate, such as would naturally result from the extensive submergence of northern, or at least of northeastern land, when the sea stood five hundred feet above its present level in the basin of the St. Lawrence, and our great alluvial plains, from fifty to three hundred feet above the present bed of the rivers, were flooded. Professor Gray alluded to the character of the herbivorous animals of that period, and their high northern range, as demonstrating that our temperate flora then reached northward far beyond the arctic circle; for that was the era of the *Megatherium*, *Megalonyx*, *Mylodon*, *Mastodon*, a *Dicotyles*, a wild horse,

&c. in the United States; when the *Elephas Americanus* ranged north to Canada, and the Siberian *Elephas primigenius* from Canada to the Arctic Sea, as well as in Europe and Asia from lat. 40° to the shores of the Arctic Ocean,— in the Old World accompanied by a *Rhinoceros*, which in Siberia ranged as far north as the Elephant. Taking this as proof that the temperate floras on both sides extended fully up to Behring's Straits,—if, indeed, these straits then existed,—Professor Gray was unable to suppose that species of plants did not come or go when the Siberian Elephant did.

This warm or mild period was followed by the *terrace epoch*, as Dana terms it,—a time of transition towards the present condition, bringing the northern part of this continent up to its present level and down to its present cool temperature, so giving to the arctic flora its present extent, and again separating the temperate floras of the New and of the Old World to the extent they are now separated.

Professor Gray observed, that he could not appreciate the objection that the admission of such vicissitudes militated against the idea of a plan in creation, and in "the adaptation of organic types to similar corresponding physical features," unless the objection goes to the extreme of implying that the present state of things so strictly represents the primitive condition as to exclude second causes, and to deny that physical influences, known to have been in operation, should have produced their natural effects in former times as well as now. Looking at the long and eventful history of vegetable species, Professor Gray was not inclined to think that the *Eriocaulon septangulare* of our Atlantic border was separately created also in the Isle of Skye and a few of the neighboring Hebrides, and in a local station on the western coast of Ireland, while it occurs nowhere else in the Old World, and has not a single generic or ordinal representative in Europe,—nor that the Ginseng was created in three widely-separated parts of the world, viz. in Eastern North America, in Japan and Mantchuria, and in Nepaul, — any more than that patches of Alpine vegetation, wholly of Labradorian species, were separately created on Mount Katahdin in Maine, the White Mountains of New Hampshire, and a few summits of the Green Mountains and Adirondacks.

As respects the vegetation of former epochs, so far was Professor Gray from conceding "that the present distribution [of *plants*] was linked with that of earlier periods in a manner which excluded the assumption of extensive migrations, or of a shifting of the flora from one area to another," that he was, on the contrary, struck with the remarkable dissimilarity between the early tertiary and the more ancient floras of Europe and America and that now existing; for example, the miocene flora of the coast of Oregon being very like that of Switzerland of the same period, and in both a tropical flora of predominant Australasian types; the eocene flora of at least some parts of Europe being prominently Australian; the flora of Europe, even since the creation of some existing species, possessing numerous North American types of which there are now no representatives whatever on that continent, &c.

In conclusion Professor Gray remarked, that, when we speculate about the *origin* of species, we launch out beyond the region of induction, and have only analogies or probabilities to guide us, which we have to weigh one against another as well as we can. And he deemed it very important to the progress of science that different investigators should start from independent and opposite preconceptions or lines of thought. His preconception was that of the local origination of species; not origination in single individuals or single pairs, — which might or might not be the case in different species. The improbability of single origin appeared to him to be great in the lower grades of animals; the probability of it greater and greater as we rise in the scale of being. But the local origination of each species appeared to him not only the natural hypothesis to begin with, as he had before remarked, but also the one which, on applying it to the case in hand, he thought best adapted to explain the actual distribution of plants. Although not inclined to defer too much to *a priori* reasoning, he thought it was suggested by philosophical considerations, as well as by the induction of observations; being a natural inference from Maupertuis's principle of *least action*, viz. "that it is inconsistent with our idea of Divine Wisdom to suppose that God would use more power than was necessary to accomplish a given end." According to Professor Peirce, this principle is strictly verified in all the mechanical arrangements of the universe; so that we cannot but think it applicable to the organic world also; — in which there would appear to be a vast waste of power, if, in the case of beings endowed with such immense multiplying power as plants, as many individuals were created *ab initio* as there were ever subsequently to be.

The discussion was continued by Professor Agassiz, who remarked that Professor Gray had fairly represented his view of the origin of animals. Botanists, he said, have considered the distribution of plants mainly in connection with the influence of physical agents, whereas zoölogists had regarded the distribution of animals from a palæontological point of view, and from this latter point of view he had himself been led to the opinion that animals were primarily distributed about as they are at the present time.

Professor Agassiz argued that climate has very little to do with the distribution or specific characters of animals, from the facts observable at the present time. Near the poles, he remarked, the conditions of existence are quite uniform, and in the tropics they are the same so far as climate is concerned. In the arctic regions we find many animals absolutely identical in both hemispheres, and many very closely related to each other; in the regions of the tropics, on the other hand, there is no similarity in the animal life of the two hemispheres, although the climate is the same. It is evident, therefore, that the peculiar characters of the Faunæ of these regions cannot be ascribed to the influence of climate. In passing from the arctic to the tropical regions, the uniformity of animal life in the former passes gradually into the extreme diversity of that in the latter, and in the causes of difference in the tropics Professor Agassiz said he saw the reasons for all differences, wherever observed. How far back, he asked, does this state of things go? In the tertiary times of Australia the peculiar types of animal life existed which give at the present time the distinctive character to its Fauna, and the same is true of the tertiary Fauna of South America. These facts, and others like them, have led him to believe that animals were primarily distributed over the surface according to a plan hardly intelligible as yet to us, but independent of climatic influences. This plan he believed included the preparation for the earth's surface and the various external conditions of their existence for its inhabitants, before they were created, very much as a householder lays his foundation and builds the superstructure and arranges the furniture of the interior for his residence before occupying it.

Professor Gray had quoted a number of plants as identical in the tertiary and the present period. Des Hayes and Lyell had admitted the same with regard to the animals of these periods. Professor Agassiz said he had doubted the fact in the case of animals, and had therefore early in his scientific career collected many specimens to settle the question, and in every instance where he had sufficient materials he had found that the species of the two epochs supposed to be identical by Des Hayes and Lyell were in reality distinct, although closely allied species. He was therefore inclined to ask whether it might not be possible that the same is the case with the plants of the tertiary period and those of the present day? He could not but believe that, if Professor Gray were to exercise the same critical judgment upon the fossil Flora which he does with reference to the existing Flora, he would find differences between the species of the two epochs similar to those found in the animal world. There is not, at the present time, he added, an equal knowledge of all the facts in Botany and Zoölogy.

Professor Agassiz referred to his former statements with regard to the similarity of the turtles of Eastern Asia and Eastern North America, and of those of Western North America and Europe, and showed how these differences seemed to be related to the geological age of these respective regions, and were at variance with the supposition of an interchange of species, such as Professor Gray believes to have occurred in the vegetable world: in the instance quoted, there is an alternation of two fields of animal life of entirely different types. In conclusion Professor Agassiz reiterated his statement, that he believed that the present races of animals were originally created on the earth in about the same proportionate numbers as they are found to have at the present time, and in about the same localities as those they now occupy.

Professor Peirce spoke of the changes of temperature which had been referred to as having influenced the distribution of plants and animals, and said he thought it an important inquiry, to discover how such a change could have taken place. With regard to the supposed cooling down of the earth, he showed that the conditions under which it could have taken place were inconsistent with the existence of plants and animals on its surface, and the time when it must have occurred must have been long before they were created. The sun's temperature, he said, might have undergone changes from time to time, but there was no proof that such had been the case; and if it had been so, the effect on the earth would have been uniform. The change of the area of the land, and the elevation of portions of the earth's surface, would account for the glacial period, and climatic and meteorological changes might have resulted from changes in the amount of the earth's atmosphere.

Four hundred and sixty-second meeting.

March 8, 1859. — Monthly Meeting.

The Academy met at the house of Dr. N. L. Frothingham.

The President in the chair.

The Corresponding Secretary read a letter from Mr. G. P. Bond, in acknowledgment of one from himself communicating the resolutions passed by the Academy on the occasion of his father's decease; and one from Mr. W. W. Goodwin, accepting fellowship.

Professor C. C. Felton made the following communication on Greek Pronunciation: —

"In the fourth volume of the Memoirs of the American Academy, published in 1818, there is an elaborate paper on the Modern Greek Language, by the late John Pickering of Boston. The materials for this learned contribution were partly gathered from conversations with a well-educated Greek, a native of Navarino, — the sandy Pylos of old Nestor, — Mr. Ciclitira,* the mate of a Greek ship then lying in the harbor of Boston. This gentleman had received a fair school education in his youth: he could read Homer well; and the letter addressed by him to Mr. Pickering does credit to his acquirements, both in chirography and style. It is an interesting illustration of the effects of what the Greek patriots have done, in the latter half of the last century and the opening of the present, to improve the intellectual condition of their oppressed countrymen. Mr. Pickering, with characteristic zeal for knowledge, seized this opportunity to investigate the actual condition of the Modern Greek language. By comparing the present pronunciation of the spoken language with the statements of the old grammarians, he came to the conclusion that it is, in all essential particulars, nearly identical with that which prevailed in the period immediately following the Christian era.

"Since Mr. Pickering's time, the Modern Greek has been more studied, and it is now understood by a larger circle of scholars. But to him belongs the honor of having, earliest among the scholars of our day, given the subject a thorough investigation, and of having published

* Τζικλιτήρας.

the results to the world. I say the scholars of our day, because, as is well known, when the study of the Greek language was generally introduced into the universities and schools of Central and Western Europe, by the learned Greeks who fled from Constantinople after the capture of the city by the Turks in 1453, it was taught with the Byzantine pronunciation of that day, and so continued to be taught until the time of Erasmus, who proposed a new but theoretical system. The Greek pronunciation of the Greek language gradually disappeared from the schools of Europe, and has never been known in the schools of America. It is now taught only in Harvard University.

"The visit of the Greek ship to the United States occurred three years before the breaking out of the insurrection against the Turks. For seven dreadful years Greece was overrun by swarthy hordes of barbarians from Asia and Africa, and was reduced to the lowest stage of poverty and distress. Yet the first revolutionary government made provision for a system of public education, adopting as fundamental principles of the provisional constitution under which the war was carried on, the universal education of the people, and the perpetual exclusion of slavery from the soil of Hellas. When, by the intervention of the great powers of Europe, a portion of ancient Greece was organized as an independent kingdom, and Prince Otho, the second son of the king of Bavaria, was placed upon the throne, the system of public education was among the earliest subjects of interest to the new government; the Constitution of 1843 embodies and extends the principles already established; and at the present moment the schools, gymnasia, and University of Greece are objects of pride and affection both to the people and the government, and are centres of light which are rapidly illuminating all that part of the world.

"The Greek language had never ceased to be the written and spoken speech of the descendants of the ancient Hellenes. It had never been broken up and supplanted by foreign dialects. Even the ancient grammatical forms and constructions had been preserved by writers, if not by speakers, down to recent times. But language is fluent and changeable. It cannot remain absolutely fixed and immutable; for the human mind, of which it is the organ, is in perpetual motion, and language silently but surely undergoes perpetual change. From Homer to Demosthenes the Greek language passed through a wonderful series of historical developments. From the time of Demosthenes to the

Christian era still further changes took place. From the Christian era to the establishment of the Byzantine Empire a similar process went on, and during the long succession of ages through which that empire lasted, the language, sharing its permanence, shared also its vicissitudes. Again, during the four centuries of Turkish oppression, the fortunes of the language corresponded to the unhappy condition of the people. It was corrupted by the intermixture of foreign elements, and participated largely in the degradation of the race; but with the reviving sense of nationality and the growing desire of independence which in the last quarter of the last century breathed the breath of a new life into the Hellenic race, and finally led in the present century to the establishment of the kingdom of Greece, commenced the process of the purification and the improvement of the language. At the present day the style of the educated, as exhibited in the literary and political journals, in the lectures of the professors, in the parliamentary debates, and in the eloquence of the pulpit, is good Greek. In all these revolutions the language of the Greeks (to borrow the expression of Professor Sophocles) has never lost its consciousness, — has never ceased in form or substance to be Greek.

"What, then, has it lost? In the pronunciation of the ancient classical languages there were two elements, both of which were carefully attended to. These elements were accent and quantity. In modern languages, on the contrary, quantity does not exist as a fixed element of pronunciation. In the ancient Greek and Latin the pronunciation of educated people combined both, and to mark them both was the test of the education of a gentleman. It was almost one of the fine arts, combining the musical proportions of time in a much larger degree than any language now spoken with rhetorical accent and emphasis. It is evident that this musical property of enunciation is more a matter of art, and less vital to language as the organ of thought, than accent or emphasis. Accordingly, when the prosperity of the state and the high standard of education began to decline, musical proportion in common speech began to disappear, and finally it was preserved only in artificial compositions, formed upon the ancient rhythmical models, and resembling the hexameters and pentameters written as school exercises in our day. Accent, however, is a vital and indestructible element, both in common and cultivated speech. More than anything else it gives significance to words. Vowels and consonants frequently modify their sounds in passing from age to age, and from country to country. But the place of an accent seldom changes. Greek vowels have been modified, but the Greek accents remain. In the English language, comparatively few words have changed their accent since the time of Chaucer. The verses of that delightful poet may be easily and intelligently pronounced by the English reader of the present day, and the accent of almost every word remains the same as when he wrote.

"What, then, has the Greek language lost? It has lost *quantity*, or the musical proportion of syllables, in its pronunciation; but it has retained the system of accents substantially as they existed in the time of Demosthenes. When the Greek was taught to the Romans in antiquity, it was taught by native Greeks, with quantity as well as with accent. When it was taught in Western Europe, after the fall of Constantinople, it was taught by native Greeks, without quantity, but with accent. In the Greek and Latin languages, quantity, though fundamentally different from accent, was connected with accent and influenced by it; but the relations between these two elements were different in these two languages. In the Greek the position and kind of accent were to a great extent controlled by the quantity of the final syllable, namely, the accent could go back no farther than to the penultimate if the final syllable was long, and might go back to the antepenultimate if the final syllable was short. In the Latin the place of the accent was controlled by the quantity of the penultimate syllable; if that was long, it was also accented; if short, the accent went back to the antepenultimate. The coincidence of accent and long quantity in the Latin penultimate has created the strange impression that accent and quantity are identical. For example, in *amaverunt*, the third person plural of the perfect tense of *amo*, the *e* in the penultimate is long; it is also accented, but it is not long because it is accented, but the reverse, — its musical measure is long, — and the accent is a greater stress of voice only; the last syllable is equally long, but is not accented; — and in the word *hominibus* the accent is on the *i* of the antepenultimate, while the quantity of that syllable is short. And yet by the English and American classical ear, accent and quantity are universally confounded; and in England and America it is supposed that, by reading Latin with the Latin accent, we are observing the quantity of that language. More strangely still, it is fancied that, by reading the Greek with the Latin accent, we are observing the quantity of the Greek. That is to say, we have adopted it as a principle, that, having lost both Greek and Latin quantity, by rejecting the Greek accent and substituting for it the Latin accent, we have acquired a true Greek pronunciation. In reality, we do not give the quantity in either Greek or Latin, and we have simply transferred the Latin accent to the Greek. We may perhaps understand the effect of this proceeding by transferring the English accent to the French language, and then reading a passage of it to a highly cultivated Parisian. In England it is as much as a man's reputation is worth to pronounce the word ἄνθρωπος with a Greek accent. The American scholar who should do so at Oxford or Cambridge would be set down as a mere barbarian. He only knows Greek who pronounces it wrong, that is, pronounces it according to the accents of the Roman tongue.

"Following the changes in the pronunciation of the language, the poetical rhythms of the Greek since the tenth or eleventh century, or even an earlier period, have been founded on accent. The first known compositions of this kind are without rhyme. The poems of Ptochoprodromos are in unrhymed iambic tetrameter catalectic: most of the Klephtic ballads are in the same measure, which is as much an established rhythm in the Modern Greek as the dactylic hexameter was in the ancient. Rhyme, however, has long been naturalized in the Modern Greek. In the poems of Christopoulos, Soutsos, Rangabes, Valaorites, and others, rhymes are as freely and naturally employed, as in those of Moore, Byron, Scott, and Longfellow.

"We must, therefore, admit that quantity is irrecoverably gone from the Greek language: in this respect, the Modern Greek stands in precisely the same position with the other modern languages. The art of combining accent and quantity is lost, and cannot be restored. Who can recall a departed sound? Who can revive the music of Linus and Terpander? Ancient sculpture may be reproduced: the models are before us. Ancient architecture may be imitated: there stands the Theseum, there stand the glorious ruins of the Parthenon. The lyres of Homer and Pindar are broken: their notes are dispersed in empty air. No living ear has heard them, and no art of the scholar can gather them up again.

"Ancient rhythms were composed to be chanted. We have substituted reading for the musical delivery of the Greek and Roman poets. For quantity we substitute accent: and it so happens, that in some of the rhythms — as the dactylic — the Roman accent more frequently coincides with the ictus of the rhythmical time, than does the Greek accent; but in many of the rhythms it does not, and it does not uniformly in the dactylic. For example, in the first line of the Æneid,

'Arma virumque cano Trojæ, qui primus ab oris,'

in the word *cano*, the natural accent falls on the short syllable *cá*, while the metrical ictus falls on the syllable *nó*. The rhythmical ictus and the natural accent coincide four times.

"In the first line of the Iliad,

Μῆνιν ἄειδε, θεά, Πηληϊάδεω Ἀχιλλῆος,

the metrical ictus and the natural accent coincide three times. Probably, take the languages through, the proportion of four to three represents the comparative frequency, in the Greek and Latin, of this coincidence. In scanning both Latin and Greek verse, we substitute accentual beat for musical time. In Latin, as well as Greek, the natural accent does not coincide with the quantity. We do not accent a Latin hexameter as we accent the words which compose it in a prose sentence. We do not accent a Greek hexameter, as we accent the words which compose it, in a prose sentence, whether we accent these words according to the Greek or Roman system. In the ancient musical recitation, quantity was so predominating an element, that accent almost disappeared; as the English accent disappears in singing an English song. By our accentual reading of ancient verses, we produce only an analogous effect, not at all an effect identical with that of the ancient musical recitation. There is all the difference between them that there is between music and reading, — between singing and saying.

"The learned Greeks of the present day admit the loss of quantity from their language; and this has been conspicuously shown by the singular fact, that some of their poets have lately introduced, among their poetical rhythms, the accented hexameter, both in original poems and in translations from the ancient classics. Alexander R. Rangabes, one of the most learned professors in the University of Athens, now the able Secretary of Foreign Affairs, — a gentleman of such indefatigable industry that, amidst all the cares and labors that fall upon him as a leading member of the Cabinet, he has never omitted a lecture in the University, — this gentleman, a distinguished poet, as well as scholar and statesman, has published several successful specimens of accented hexameters. In a dramatic poem entitled *Φροσύνη*, founded on the tragic episode of Gardiki, in the reign of Ali Pacha of Iannina, the description of the bloody transaction is given by the priest Meletios of Gardiki, in accented hexameters, commencing as follows: —

Ἦτον ἡμέρα λαμπρά, ἀνθοφόρος τοῦ ἔαρος κόρη
Ῥοδοστεμμέν' ἡ αὐγὴ εἰς τοὺς λόφους γελῶσα ἐφάνη
Καὶ τὸ Γαρδίκι ἀκόμη ἀπέσειε μόλις τοῦ ὕπνου, κ.τ.λ.

The same author translated the first book of the Odyssey into accented hexameters. I give the first two lines of the original, and then the corresponding two lines of the translation, for the purpose of comparing both the ancient and modern rhythms and the ancient and modern language, begging you to remember that Homer lived three thousand years ago, and that Rangabes is still a young man.

Original.

Ἄνδρα μου ἔννεπε, Μοῦσα, πολύτροπον ὃς μάλα πολλά,
Πλάγχθη ἐπεὶ Τροίης ἱερὸν πτολίεθρον ἔπερσεν.

Translation.

Ψάλλε τὸν ἄνδρα, θεά, τὸν πολύτροπον, ὅστις τοσούτους
Τόπους διῆλθε, πορθήσας τῆς Τροίας τὴν ἔνδοξον πόλιν.

Another instructor in the University, Theodorus G. Orphanides, Professor of Botany, but cultivating the flowers of poetry as well as those of natural science, encouraged by the success of his colleague, has tried his hand upon accentual hexameters, and obtained the prize in the poetical competition of 1855 for a poem in this measure, entitled, 'Anna and Phloros, or the Tower of Petra.' In his Preface to this poem he says: —

"'This measure has been until very recently neglected or despised by most of our modern poets. And although many scholars both before and after the Revolution made hexameters, their verses nevertheless — an imitation seldom beautiful of the Homeric lines — appeared unharmonious to the most delicate ears, on account of the loss of our ancient prosody. Grammatically considered, they were perhaps wonderful; with reference to harmony they were anything but verses.

"'This immortal measure awaited a new artist to acquire fresh life without losing anything of its ancient dignity, and that its harmony might be felt by the ear of the modern Greek, who now only accents the words, and does not mark the long or short syllables. Mr. Alexander R. Rangabes was the first to attempt this. In his tragedy, Phrosyne, Meletios describes in hexameters the heart-rending catastrophe of Gardiki, perpetrated by the bloodthirsty Ali Pacha, and in his poems since published there is a flowing translation of the first rhapsodies of the Odyssey, and a dedicatory letter to Professor Doucas written in hexameters.

"'I am not ashamed to confess that while reading these felicitous attempts I felt for the first time all the charm of this measure, and now, years after, I have dared to follow an example so worthy of imitation.'

"The poem opens as follows: —

Κεῖτ᾽ ὑψηλὸς μεταξὺ τῶν Θηβῶν καὶ τοῦ Δήμου τῆς Πέτρας
Πύργος βαρβάρου ῥυθμοῦ, πρὸς δυσμὰς καταρρεύσας ἐν μέρει
Ἔχων τὴν βάσιν ἐγγὺς τῶν ὀχθῶν τῆς καλῆς Κωπαΐδος, κ. τ. λ.

"Upon this state of things an old question comes up with new urgency for the scholars of the present day to consider, and that is, whether we ought to continue to pronounce the ancient Greek language without quantity and with the Latin accent, or to attempt the restoration of the ancient union of quantity and accent, or to adopt the modern pronunciation. The question may not be one of vital importance, but it is one of practical convenience in teaching that classical tongue. And it has called out much discussion among the scholars of Europe. There is no doubt that the modern pronunciation is gaining ground. The venerable Professor Thiersch, of Munich, has long advocated it, having many years ago visited Greece and learned the spoken language of the country. Throughout Germany the Greek is pronounced according to its own accents, and not according to the Roman, though the modern sounds of the vowels have not been generally adopted. In England, Mr. G. J. Pennington published in 1844 an elaborate work in octavo, agreeing in his conclusions with those of Mr. Pickering, and strongly advocating the Modern Greek pronunciation. Sir George F. Bowen, also an English scholar well known for his travels in Greece, lately appointed Secretary to the Lord High Commissioner of the Ionian Islands, and married to an accomplished Greek lady of the noble family of Roma, is very naturally a warm advocate of the Modern Greek pronunciation. Professor Blackie, of the University of Edinburgh, the admirable translator of Æschylus, has written several excellent essays on the same side. He, too, has learnt the living pronunciation of the language among the scholars of Athens. Animated by his example, a young Scotch scholar, James Clyde, left his employment as a classical teacher for the sake of studying the Modern Greek under the shadow of the Acropolis. And since his return, in 1854, he has published a little book on the subject, which has received the well-deserved praises of an elegant scholar and most competent judge, Lord Broughton, author of the Travels in Albania. Many other European scholars have visited Greece, and all, so far as I know, have come to the conclusion that the wisest course to take would be to adopt the pronunciation of the cultivated Greeks of the present day. As things are now, there is no uniform system. The English, Scotch, Irish, French, Germans, and Americans have different methods, and even in different schools of the same country different systems of pronunciation prevail, and in some schools of every country there is no system at all. It may be objected, as it often is, that the modern Greeks neglect the quantity of syllables. That is true; but it is equally true of each and all the other systems of pronunciation. It may also be objected, that by reading Greek with the modern accent we spoil the rhythm of the ancient poets, and this is partly true; but it is also true of the system of reading Greek with the Roman accent. In the schools of Greece, the difficulty is overcome by scanning the verses just as we do; that is, by marking the rhythmical ictus with an accent, and not attempting to render the ancient musical time. Their two modes of reading, the one with the natural accent and the other with a rhythmical accent, are no more incongruous, than our two modes of reading Greek, the one with a Roman accent and the other with the rhythmical accent. Another objection is, that the modern Greeks have corrupted the ancient sounds of the vowels, and this is undoubtedly true. But the *Eetacism* with which the Modern Greek has been reproached may be traced back beyond the Middle Ages, perhaps to the Christian era. It would undoubtedly be a gratification to taste and curiosity, if we could ascertain and reproduce exactly the tones and qualities of the vowels as they were sounded from the lips of Demosthenes speaking to the Athenian Demos from the Bema. But this can be done only partially, if at all; and the question recurs, Is it not better to adopt the living pronunciation of a people whose existing language is inherited from an illustrious ancestry? The scholars of the world would at least gain these advantages: they would have the same pronunciation everywhere; they would have the pronunciation of a living and intellectual race, consisting of twelve or fifteen millions of souls,—of a race who are making gigantic strides in education, literature, and science, and who are destined to restore the fair regions and the sunny islands of the Ægean Sea, which have been so long blighted by the presence of barbarous conquerors, to civilization and Christianity."

Mr. B. A. Gould remarked that the subject was interesting, but he was not prepared to abandon the received pronunciation, and to adopt the accentual system of the modern Greeks. He thought the system generally adopted by the English and Americans furnished the means of a uniform standard, and that a departure from it would introduce confusion. Besides, the Modern Greek pronunciation not only destroyed the rhythm, but injured the effect of those passages in Greek poetry, in which the sound was supposed to correspond to the sense, as in the πολυφλοίσβοιο θαλάσσης of Homer, which, with the modern pronunciation, would be *polyphleesveo thalasses*. For these, and other reasons, he was not in favor of adopting the Modern Greek pronunciation.

Mr. Felton replied, that, in point of fact, the pronunciation of the present day in Europe and America furnished no uniform standard. Even in England, the pronunciation of Greek is far from uniform; and every nation differs from every other nation. In America different systems prevail in different parts of the country, and in many places there is no system at all. Now, by adopting the Modern Greek pronunciation, all nations would have a standard easily accessible; and really, it seemed to him that the only way to have any standard at all was to take the pronunciation of the living Greeks, just as we take the pronunciation of living Frenchmen for our standard in the French.

As to those passages alluded to by Mr. Gould, in which the sound is an echo to the sense, no doubt there is much in that idea; but it still remains to decide what is precisely the sense intended in any given passage. The words cited by Mr. Gould are part of a line, describing the priest Chryses as he departed from the Grecian camp, disappointed in the hope of recovering his captive daughter: —

Βῆ δ' ἀκέων παρὰ θῖνα πολυφλοίσβοιο θαλάσσης.

"And he went silent along the shore of the much-resounding sea."

Now, what sea, and what sound of the sea, are we to understand? Is it the Atlantic Ocean, driven by a winter storm, and breaking and roaring against the rocks of Nahant? No. It is the sparkling Hellespont, on a summer day, sweeping up the long beach on the coast of Troy, and rippling over the sands, as he had often seen and heard it, while riding at anchor, or sailing by those classic shores; — and this sound is more nearly represented by the Modern Greek *polyphleésveo thalássēs*, than by our more sonorous but somewhat mouthing way of pronouncing the words.

Mr. Charles Folsom remarked, that the discussion brought to memory an incident in his early travels. He was formerly of Mr. Gould's opinion; but on one occasion, in Smyrna, he was walking with an accomplished Greek gentleman, when the conversation turned upon this question. He had cited to his Greek friend the very passage cited by Mr. Gould. The Greek gentleman reminded him that they were now in the midst of the scenes familiar to Homer from his earliest youth (the Smyrniotes still claim Homer for their countryman), and the water of the beautiful harbor of Smyrna rippling against the shore, as they beheld it at the moment, was what the poet was describing. Mr. Folsom further remarked, that reflection and observation had convinced him that the only mode of securing uniformity in the pronunciation of the Greek was to adopt that of the Modern Greeks.

Remarks were also made on the communication of Professor Felton by President Quincy, Dr. Jacob Bigelow, and the Rev. Thomas Hill.

Dr. Pickering called the attention of the members to the *Coptic alphabet*, formed as early at least as the fifth century, and affording evidence that, from the time of its formation, little or no change has taken place in the pronunciation of the Greek letters. This result was arrived at by comparing Professor Sophocles's account of the Modern Greek pronunciation, and especially the chapter in which he undertakes to spell English words with Greek letters.

In applying the Greek letters to the Coptic language, the Copts first exhausted the Greek alphabet; and for the remaining articulate sounds, that could not be expressed in Greek, were obliged to invent new characters. Accordingly, we observe: —

1. That, the sound of the English *d* not existing in the Greek language, the Copts were obliged to invent a new character to represent this sound.

2. That, though the Copts made use of the Greek ϕ, they were not satisfied with it; but invented a new character for the full Roman and English *f*.

3. That the Copts invented a new character for the sound of the English *h*.

4. That the Copts rejected the Greek γ, and invented a new character, that seems to correspond to our English *g*, or *gh*.

5. That the Copts invented new characters for *tsh*, or the Italian *c*; for *dsh*, or *g* soft; and for the English *sh*; none of these three sounds existing in Greek.

Dr. Pickering regarded several of the Greek sounds of letters as deviations from normal original sounds, but deviations which have been transmitted from a very ancient period. He had, however, obtained evidence that the normal sound originally belonging to the character B was much as in the Greek, — was, in fact, easy respiration, or the English *v*.

When writing first began to be practised, there seem to have been no superfluous letters; and the Greek language in the course of ages has unquestionably experienced some losses. It may be regarded as certain that the three vowel-characters, η, ι, υ, were not originally sounded alike. The Greeks have also lost the digamma, or *w*. Aristophanes gives the voice of the pig as κοι, or *kwee*: it may therefore be inferred, that in his day οι was pronounced *wee*, and οικος, *weekos*; but in spelling *week*, a modern Greek would be obliged to place a prefix to the ancient word, for instance, ουοικ.

Professor Peirce presented a communication from Mr. Safford on the mode of determining the places of planets, and one by himself on the personal peculiarities of astronomical observers.

On motion of Professor Parsons, it was voted that Mr. Safford's paper be referred to Professor Peirce for examination.

Dr. C. T. Jackson exhibited specimens of Tetradymite, or tellurid of bismuth, from Spottsylvania in Virginia; also an allied new mineral from Dahlonega, Georgia, viz. Bornit, with its composition and formula; he also exhibited gold from the same mine, in the matrix as well as washed, and gave an account of the gold-washing processes carried on in that State.

Four hundred and sixty-third meeting.

March 22, 1859. — SUPPLEMENTARY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from Sir William E. Logan, Montreal, March 7th, and from John Lindley, London, February 28th, in acknowledgment of their election, the former as Associate Fellow, the latter as Foreign Honorary Member of the Academy; also from William Sharswood, Philadelphia, March 17th, offering certain books for the acceptance of the Academy, and proposing certain exchanges.

The discussion at the last special meeting was continued by Dr. Charles Pickering, who read the following paper upon the subject: —

"Dr. Pickering had been practically engaged with the subject, in *ascertaining* the geographical distribution of species; had visited, and acquired local knowledge, at many different points of the earth's surface; and anywhere upon the planet would probably know his whereabouts by looking at the animals and plants.

"He regarded the subject as destined to throw light upon history; but, as far as he was connected with it, instead of applying his experience, he had been called upon to impart it.

"He had constructed illustrative maps: yet, even with their aid, personal inspection seemed indispensable, extending to the species absent from a country, as well as those present. After various unsuccessful trials, he had adopted a plan of numbering the species geographically, according to the countries arranged in a particular order: the numbers will then supply the place of personal inspection, will point out where a genus or a species commences, and in a general way where it terminates: by following always the same conventional route, some idea of the distribution of species may perhaps be gained, without actual voyaging.

"In regard to the origin of species, Dr. Pickering's observations have all tended to confirm an opinion he has long entertained. The term 'local areas' is, however, not his own; but seems preferable to that of 'centres of diffusion,' formerly used by him, and he will adopt the improvement. He considers, then, that *species originated upon local areas;* and are spread over as much of the earth's surface as they have had a chance to reach and occupy.

"He regards the question as half decided by the fact, that very many species are confined to local areas to the present day; often, too, under circumstances that seem to preclude wider diffusion at any former period.

"1. The class Mollusca affords instances of the two extremes in diffusion; many of the land species being local, and many of the marine species widely diffused. At the Hawaiian Islands, each separate island has in a general way its own set of *land shells;* some species, at least, that do not reach the other islands of the group, nor reappear upon any other portion of the globe. While among the *marine shells*, he had himself seen living specimens of the *Cyprea tigris*, or leopard cowry, at the Hawaiian Islands, as at other points in the Pacific, and throughout the East Indian Archipelago and the Indian Ocean to the African coast, a distance from east to west of fifteen thousand miles. The explanation probably rests in the ova; those of the *Cyprea tigris* being marine, and preserving their vitality in sea-water, and those of the land mollusks perishing on immersion.

"2. The *Anseridæ,* or species of goose, are grazing birds, and, being thickly coated with feathers, inhabit in preference chilly climates, arctic or else antarctic. The dreary summits of the Peruvian Andes are, however, inhabited by a peculiar species of goose; and another peculiar species occurs in the Hawaiian Islands, upon Mauna Roa, — only upon this one mountain, keeping amid or just above the zone of clouds, at the elevation of 6500 to 7000 feet, but visiting the country below, a small flock being often met with around the great crater. There are probably not more than three or four hundred pairs of this bird in existence; nor, perhaps, have there ever been at any one time; but commercial demand, should it ever arise, might in a few years multiply the pairs into millions, scattered all over the globe.

"3. The ocean-island of St. Helena is quite small, and its whole outer and lower portion is desert. On the very summit, comprising only five or six square miles of surface, some remarkable species of plants are growing, not to be found elsewhere. There seems no escape from the conclusion, that within this limited space on St. Helena the creative act has been exercised.

"This exercise of creative power took place many thousand years ago, as can be determined approximately. The *coral-islands* in the Pacific are many of them as widely insulated as St. Helena, and of larger area; but coming out of the water after the existing species of animals and plants had been created, too late for the visit of creative power, they contain no additional species. This, at least, is certain in regard to the low coral-islands: and as to the two or three minute land shells on the elevated coral-island of Metia, while so many rocky islands widely scattered around remain unexplored, it will not be safe to draw conclusions.

"That species continue unchanged in aspect during thousands of years, there is abundant evidence; — in the imbedded shells of these same coral-islands, for many ages above the waves, yet exactly similar to wave-washed living species close at hand; — in the animals and plants figured fifty-five hundred years ago on Egyptian monuments, in every instance identical with living species; — in the bodies of a variety of animals mummified in Egypt during the last three thousand years; — and in Gliddon's mummy of a man who lived in the days of the prophet Elijah, showing that that generation did not differ physically from ourselves."

The special subject for the evening's discussion, namely, the Classification of the Animal Kingdom, as exhibited in the palæozoic period, was next treated at length by Professor Agassiz.

In reference to Professor Agassiz's communication on the paleozoic animals, all of them aquatic, Dr. Pickering remarked, that the *oceanic animals* of the present day are almost as universally diffused as were those of paleozoic times. At least, a division into tropical and non-tropical will require the oceanic tropic to be placed full fifty degrees from the equator: there will then remain, outside of this belt of a hundred degrees, a few oceanic species that may be regarded as non-tropical.

Dr. A. A. Gould mentioned the fact that the land shells of the Sandwich Islands are peculiar in being distinct in their characters for each island: they are species of the genus *Achatinella*. The island of Metia has three species peculiar to it. The shells of the Feejee Islands do not resemble those of the Navigator's Islands, but are like those of the Society Islands, twenty degrees distant; a fact which Dr. Gould considered evidence of the former existence of an extensive continent now submerged.

Dr. Pickering said he did not think there was knowledge enough as yet of the shells of the Society Islands in the possession of naturalists to assert positively that the Metia shells do not exist on them. If this be really the case, it would be evidence of comparatively modern creation, as the island of Metia is a coral-island.

Professor Agassiz mentioned that even the fishes of different islands of the Sandwich group differ from each other, as had been proved by specimens in his possession.

Professor Gray, in a brief rejoinder to the remarks of Professor Agassiz upon his communication at a former meeting (p. 177), suggested that an obvious reason why the terrestrial species of the arctic regions were so generally alike round the world, while those of the temperate zone were less so, and those of the tropics mostly different, might be found in the geographical position of the regions in question, — the masses of land in the former being essentially contiguous, in the latter widely remote; so that species might naturally have been diffused round the whole circumpolar regions, but this could not be expected in the widely separated tropical regions, except as to maritime species; and, in fact, the strictly maritime plants were largely the same on both sides of the ocean. That is, the actual distribution was *as if* species had spread over as much of the earth's surface as they have had a chance to reach and occupy. Professor Gray, moreover, did not think that "the climate is the same" throughout the tropical regions of the two hemispheres, or comparable with the arctic regions in respect to uniformity, but he supposed that the great diversity of species in the former stands in relation to diversities of climate, station, and other physical circumstances, though these, of course, are not the cause of the diversity. Finally, the interposition in Western North America of a flora generally different from that of Japan and of Eastern North America, Professor Gray thought perfectly compatible with the theory of an interchange between the two last, since the line of dissemination must have followed the isothermals, — the curves of which appear to have been essentially the same in tertiary and post-tertiary times, — and therefore trended far to the north on the western side of the American continent, leaving the existing Oregon-Californian flora always as peculiar as now.

Dr. C. T. Jackson read an analysis of a specimen of Bornite from Dahlonega, Georgia, as follows: —

"Form, hexagonal plates, which split like mica, or molybdenite. Lustre, brilliant metallic; color, between that of tin and polished steel; flexible; sectile; hardness, $2\frac{1}{4}$; density, 7.868.

Results of Analysis of 1 *Gramme.*

Bismuth,	0.7908
Tellurium,	0.1800
Selenium,	0.0118
Gold (in fine scales),	0.0060
Loss,	0.0114
	1.0000

"This species has not been found heretofore in the United States, and is exceedingly rare in Europe."

Four hundred and sixty-fourth meeting.

April 12, 1859. — MONTHLY MEETING.

The Academy met at the house of Dr. J. M. Warren.

The PRESIDENT in the chair.

Professor Peirce reported favorably on Mr. Safford's paper, which had been referred to him at the last monthly meeting, recommending its reference to the Committee of Publication. The report was accepted, and the recommendation adopted.

Dr. Warren exhibited a specimen of *Cheironectes*, and explained some of its peculiarities of structure and habits.

Dr. Warren also exhibited a suite of specimens of crania and casts of crania of the different species of Ourang, including the great *Troglodytes Gorilla* of Western Africa, together with stuffed specimens of the Chimpanzee: he pointed out the characteristic features of the different species, and exhibited lithographic illustrations of the gigantic Gorilla now in Paris. He also exhibited specimens illustrating the progress of the new art of photolithography.

Professor Peirce gave the following abstract of a memoir on the personal peculiarities of astronomical observers.

"The first portion of this memoir considered the changes which occur in the personal equations of observers. The materials for this inquiry were derived from that vast reservoir of astronomical investigation, the 'Greenwich Observations,' since it has been under the able administration of Professor Airy. The mode of determining the personal equation adopted at this observatory, from the regular observations, and not from especial observations instituted for this purpose, is the only one which is safe and trustworthy. From these observations, it appears that observers differ greatly from each other in the continuity and regularity of their habits. There are those who retain for many years, as nearly as it can be ascertained, an invariable personal equation. Others change uniformly and regularly. Others seem to vary by a uniformly increasing or decreasing rate of change; while others, on the contrary, are subject to sudden and abrupt variations, in which there is no evidence of law. Examples were given of all these various peculiarities.

"In the second portion of the memoir, the mental time-scales by which different observers subdivide the second were subjected to analysis, and the extraordinary gain to science which has accrued from the American method of observation was carefully discussed. The time-scale of each observer was inferred from the relative number of times which each tenth of a second occurred in his observations. It was shown that the habits of the observer were invariable in this respect, and were not subject to change with time or circumstance. It was also shown that the reference of this peculiarity to the inequality of the time-scale was the only just and consistent theory. It appears that, although some of the oldest and most experienced observers, such as Henry and Main of the Greenwich Observatory, are peculiarly prone to excessively defective time-scales, from which the younger observers, such as Ellis, Dunkin, and Rogerson of Greenwich, and Keith and Almy of Washington, are comparatively free, yet the veteran Argelander manifests, in this respect, the great superiority of his training. But with the American method the irregularity of time-scale vanishes, and in this first step with which America has commenced its astronomical career, we must, when we examine it historically and critically, claim to recognize the future promise of the country in this science, when the field shall be fairly opened. The American method is the unquestionable product of the Coast Survey of the United States, and was the legitimate result of the rigid and profound methods of research which are uniformly adopted in this magnificent work. The first conception was in the mind of the Superintendent himself, Professor Bache, and its complete development and ultimate success were owing to the united action of Professor Bache and his friend and assistant, Mr. Sears C. Walker. The details of the instrumental invention and execution were intrusted to Messrs. Saxton, Bond, Mitchel, and Locke. Different plans were proposed, but that of Mr. Bond is the one which is at present adopted in the Coast Survey, although some of the others possess peculiar advantages, which deserve further examination and experiment. The ingenious apparatus which has been adopted by Professor Airy, at Greenwich, differs radically from either of the American forms, although this distinguished astronomer candidly admits the American origin of the method, and states distinctly that 'the practical introduction of galvanic chronographic apparatus, in a form available for the purposes of an observatory, is entirely due (so far as I am aware) to American astronomers.' The injurious effect of introducing the make-circuit signal instead of the break-circuit signal, which latter has been rigidly insisted upon by Dr. Gould, is quite manifest in the Greenwich record. There are other difficulties, however, of a more recondite nature, which deserve thorough examination, as well as those of the other methods, none of which have received the proper investigation from the different inventors, although they cannot fail to be detected or explored by the severe criticism of the Coast Survey. This research would be materially accelerated, if our observatories would devote a due proportion of labor to the use and investigation of the established and received methods of observation with which they are so generously endowed and so magnificently equipped, instead of employing the great mass of their time in the invention of new processes, and should recall the fundamental principle of their existence,— *that science, and not art, is the final end of an astronomical observatory.*"

Dr. C. T. Jackson exhibited specimens of vegetable wax from Japan, together with specimens of the fruit of the plant from which it was obtained, a species of Rhus (*R. succedaneum*, L.). He also showed a fragment of a Trilobite in calcareous slate from St. Mary's Bay, Newfoundland, probably a Paradoxides.

Mr. H. J. Clark made the following remarks: —

"A few months ago a French physiologist, Pouchet, revived the long-exploded doctrine of equivocal or spontaneous generation, and asserted that he had been able to obtain certain living beings from substances which were entirely shut off from the outer world, and in which, after having undergone certain preparations, there could not possibly be any germs of these animals. A discovery, which I made on the 20th of March, may not be uninteresting, as it has more or less relation in its nature to the theory so earnestly advocated by Pouchet. There are certain well-known bodies described as animals by Ehrenberg, under the name of Vibrio; their peculiarity consists in that they are composed of a single row of globular bodies, resembling a string of beads, more or less curved, and move in a spiral path with great velocity, even faster than the eye can follow in many cases. They exhibit, by their activity, more plausible signs of animality than any of the Desmideæ or Diatomaceæ, and fully as convincing indications of life as the spores of Algæ, to which they were first referred by the late lamented Dr. W. J. Burnet, and after him by Rudolph Wagner and Leuckart. They have always been spoken of as developing around decaying animal and vegetable matter. I was very much surprised to discover the manner in which they originate from such substances. I was studying the decomposing muscle of a Sagitta, a little crustacean, as I consider it, — which, in passing, I would observe was found by me a year ago last March, for the first time in this country, at Lynn Harbor, — when I noticed large numbers of Vibrio darting hither and thither, but most frequently swarming about the muscular fibres. I was struck with the similarity of these bead-like strings to the fibrillæ of the muscle, and upon close comparison I found that the former were exactly of the same size, and had the same optical properties as the latter. Some of these appeared to be attached to the ends of the flat, ribbon-like fibres, and others at times loosened themselves and swam away. I was immediately impressed with the daring thought, that these Vibrios were the fibrillæ set loose from the fibres; but as this was a thing unheard of, and so startling, I for the time persuaded myself that they must have been accidentally attached and subsequently loosened. However, I continued my observations until I found some fibres in which the fibrillæ were in all stages of decomposition. At one end of the fibre the ultimate cellules of the fibrillæ were so closely united, that only the longitudinal and transverse striæ were visible; further along, the cellules were singly visible, and still further they had assumed a globular shape; next, the transverse rows were loosened from each other excepting at one end; and finally, those at the extreme of the fibre were agitated and waved to and fro as if to get loose, which they did from time to time, and, assuming a curved form, revolved each upon its axis and swam away with amazing velocity. There was no doubting, after this, the identity of the Vibrios and the muscular fibrillæ; but I thought such a strange phenomenon ought to have a second witness to vouch for it, and therefore went for the best that could be wished for, Professor Agassiz. I simply placed the preparations before him, and, without giving him the least hint of the origin of the muscle, I was pleased to have him rediscover what I had seen but fifteen minutes before. The number of ultimate cellules in a moving string varied from two to fifty; the greatest number of strings were composed of only three or four, often six to eight, and rarely as high as fifty. Very rarely the fibres split longitudinally, and in such instances the fibrillæ were most frequently long, and moved about with undulations rather than a wriggling motion. A single ultimate cellule, when set loose, danced about in a zigzag manner; but whenever two were combined, the motion had a definite direction, which corresponded to the longer diameter of the duplicate combination; and if only three were combined, the spiral motion was the result of their united action. What it is that causes these cellules to move, I do not profess to know, but certainly it is not because they possess life as independent beings. This much is settled, however, that we may have presented to us all the phenomena of life, as exhibited by the *activity* of the lowest forms of animals and plants, by the ultimate cellules of the decomposed and fetid striated muscle of a Sagitta. I do not pretend to say that everything that comes under the name of Vibrio or Spirillum is a decomposed muscle or other tissue, although I believe such will turn out to be the fact; but this much I will vouch for, and will call on Professor Agassiz to witness, that what would be declared, by competent authority, to be a living being, and accounted a certain species of Vibrio, is nothing but absolutely dead muscle."

Professor Agassiz corroborated Mr. Clark's statements most fully, and spoke of the discovery as one of the very greatest interest and importance.

Dr. A. A. Gould, in reference to the discussion on the distribution of plants and animals, made some statements, illustrating the power of external agencies, with reference to the shells of Japan. Out of nearly nine hundred shells from these islands which he had examined, only seventeen had been found both on the island of Niphon and on Jesso, which are separated by a passage of only some forty miles in width. The fact is accounted for by the existence of a strong marine current from the north and west, which passes through the strait.

Dr. Asa Gray communicated two papers, as follows: —

I. Characters of *Ancistrophora*, a new Genus of the Order

Compositæ, detected by Mr. Charles Wright in the Eastern Part of Cuba.

II. On the Genus *Croomia*, and its place in the Natural System.

Four hundred and sixty-fifth meeting.

April 26, 1859. — Supplementary Meeting.

In the absence of the President and Vice-President, the Corresponding Secretary took the chair.

The Corresponding Secretary read a letter from the Asiatic Society, dated Calcutta, December 10, 1858, acknowledging the receipt of the Academy's publications.

Professor Peirce gave the following analysis of his memoir upon the Tail of Donati's Comet.

"1. The theory proposed by Bessel, in Vol. XIII. of the *Astronomische Nachrichten*, is adopted as the basis of the theory, and it is proposed to determine the special values of the repulsive force from the sun, and of the initial impulse given by the comet, which are most reconcilable to the observed phenomena. In the first approximation, the initial impulse was neglected, because it was assumed to be quite small.

"2. Rigorous formulæ are adopted in place of the approximations given by Bessel, which are only available at a short distance from the head of the comet, whereas the critical portions of the investigation are those which apply to the part of the tail which is most remote from the head. The approximate formulæ were employed by Pape in his researches upon Donati's comet, which is astronomically designated as 1858 V.

"3. The observations of the tail which have served as the basis to this investigation are those given by Pape in the *Astronomische Nachrichten*, and an admirable series made at the Dudley Observatory, by Mr. Searle and Mr. Toomer, under the judicious direction of Dr. Gould.

"4. The observations of the front edge of the Donati comet are very well satisfied by a solar repulsive force $= -1\frac{1}{2}$, if gravity is adopted as the unit of force. The comparison of theory with observation was illustrated by diagrams, in which the observations were all combined into three tails, which may be designated as *normal tails*, and of which the dates were respectively the second, the ninth, and the fifteenth of October.

"5. An attempt was next made to satisfy the observations by a sensible initial velocity arising from the action of the comet's nucleus, and in which there should be neither repulsive nor attractive force exerted upon the particles of the tail. But it was found impossible to accomplish this result.

"6. It was found equally impossible to satisfy the observations by Pape's theory, in which the solar force is supposed to be attractive, or slightly repulsive; and the difference between this result and that obtained by Pape must be attributed to the defects of the approximative formulæ employed by Pape. It may otherwise be regarded as objectionable to Pape's theory, that it assumes the solar force to be so variable in its action, and the initial velocity arising from the action of the comet's head to be so large.

"7. In the present theory, however, the solar force is not found to be constant for all the particles of the tail, but to vary from the extreme repulsion $= -1\frac{1}{2}$ down to zero, or even to be attractive for the particles upon the back edge. But the back edge is so badly defined, that the observations upon it cannot contribute much to the accuracy of these investigations.

"8. The streaks of light, which were observed about the time of greatest brilliancy, towards the extrêmity of the tail, are probably to be attributed to the continuous discharge of material from different points of the nucleus. It was an amusing and juvenile play of fancy which saw in this phenomenon indications of concentration into new comets.

"9. The suggestion that the dark line in the tail, near the head, may be shadow, is quite absurd. The shadow of so small a nucleus could not have been in the least degree perceptible to us, and the accurate measures which were taken, as they should have been, by the most competent observers, show that the direction of this dark line sensibly deviated from that of the radius-vector from the sun, which must have been the direction of a shadow. A *diverging* shadow in this case is too preposterous for argument. The darkness can only be explained by an actual deficiency of the matter of the tail, and corroborates the inference from the form of the tail, that the matter is not ejected from the head with any great velocity, but that it passes off before and behind, so as to be but little expanded in a direction perpendicular to the plane of the orbit.

"10. The successive envelopes ascend uniformly towards the sun, at the rate of about thirty-five miles an hour.

"11. This law of ascent is peculiarly consistent with that of a vapor in an atmosphere. The appearance of the envelope of Halley's comet in 1835, as described by Herschel, was also that of a fine vapor.

"12. The uniformity of the law of ascent is irreconcilable with the hypothesis of a mass rising in a free space under the combined action of accelerating and retarding forces, which emanate from the comet and the sun. The continuance of the ascent by the same law, during the approach to perihelion and the removal from it, is opposed to the ingenious explanation of Herschel, which attributes the apparent increase of magnitude, when the comet recedes from the sun, to the deposit of vapor as the comet cools. The phenomena exhibited by other comets seem to confirm these views.

"13. The great extent of atmosphere which this theory, or that of Herschel, requires the comet to possess, involves the necessity of a much greater mass of the comet than is usually supposed, although the mass will not exceed the limits adopted by Laplace in the case of Lexell's comet. While, on the other hand, the small volume of the nucleus into which this mass is chiefly concentrated will give a density to some of the comets which will exceed that of the planets, and even be metallic in its nature. With such a mass and density, the blow of a comet might be quite disastrous to the inhabitants of a planet. The metallic density of the two comets of 1680 and 1843, which approached so near the sun, seems to be a necessary condition for the preservation of their internal continuity and coherence, when they are melted by the great heat of the sun. This metallic character of the comet is analogous to that of meteoric stone.

"14. The nearly spherical outlines of the envelope are simply results of uniform ascent of a vapor; but they differ sensibly from the level surfaces which would be given either by the theory of Roche or by that of Herschel.

"15. After a careful examination of the observations of the head of the comet, Pape did not find any established law of vibration, like that which Bessel demonstrated in the Halley comet of 1835. But from a new examination, upon a different basis, it appears that there was such a vibration, that each new envelope had its own initial period of vibration, that there was one common law of vibration, and that the vibration continued as long as the envelope was near the nucleus. The phenomena seemed to be those which would be exhibited if the nucleus were in a state of magnetic oscillation, as suggested by Bessel, or if it were rotating about an axis pointed towards the sun, and if each envelope were projected from a different point of the comet's surface.

"16. The phenomenon attributed to the resisting medium would be fully as accurately explained in the mode suggested by Herschel. The loss of the repelled matter must involve an apparent augmentation of the weight of the attracted portion without that corresponding increase of velocity which is required to preserve the mean distance and time of revolution. Thus, in the equation

$$\frac{v^2}{\mu} = \frac{2}{r} - \frac{1}{a},$$

the increase of the denominator of the first member is analytically the same with the decrease of the numerator; or, physically, to increase the gravity is the same as to decrease the velocity. The apparent resistance, in the case of Encke's comet, might be accounted for by a loss of about $\frac{1}{30000}$ of its mass at each return. But even without the loss of mass, an approach to the same phenomenon would result from the mere separation of the polar forces of the comet under the solar influence, which would draw one portion towards the sunny side of the comet, and drive the repelled force to the opposite side.

"17. The driving off the tail would tend to give rotation to the comet, or rather to return to the comet as rotation part of the force which had been taken out as translation. The opposite phenomenon might be exhibited in the case of a planet, on account of its rotation being in the same direction with the revolution of the planet about the sun. It is possible that this may account for the decrease of mean motion, which is indicated, with some uncertainty, by Leverrier's profound investigations of the planet Mercury, so that there may be exhibited a transformation of rotation into translation.

"18. The formation of the comet's tail is not without analogy in the terrestrial phenomenon of the thunder-cloud. Here, at least, is exhibited the phenomenon of a vapor rising in an electrified condition, under the action of the sun. Were the earth to be carried near enough to the sun, the clouds which were properly electrified would be repelled, and might be driven off to form a terrestrial tail. It may be, indeed, that the Aurora Borealis is the exhibition of such a phenomenon."

Remarks were made on Professor Peirce's communication by Professor G. P. Bond and Professor W. B. Rogers.

Dr. B. A Gould referred to the recent decease of Manuel J. Johnson, Director of the Radcliffe Observatory of Oxford, and introduced the following resolutions.

"Whereas, by a recent afflicting dispensation of Providence, Manuel John Johnson, Director of the Radcliffe Observatory of Oxford, has been suddenly removed from the field of his useful labors, and the Academy deprived of one of its bright and valued ornaments, —

"*Resolved*, That the Academy has heard with pain the sad announcement of this severe bereavement, lamenting the heavy loss which Science has sustained by the removal of one of her most successful and devoted ministers.

"*Resolved*, That the sympathies of the Academy be offered to the family of the deceased astronomer, together with the assurance that the name, example, and character of their departed husband and father will long serve as an incentive and example to those who aim at progress in the high calling which he adorned."

On motion of Professor Peirce, the resolutions were unanimously adopted.

Four hundred and sixty-sixth meeting.

May 10, 1859. — Monthly Meeting.

The Academy met at the house of the Hon. Nathan Appleton.

The President in the chair.

The Corresponding Secretary read a letter from the Secretary of the American Antiquarian Society, dated April 27, 1859, communicating the thanks of the Society for the use of the Academy's hall.

Mr. H. J. Clark made the following remarks on apparent equivocal generation.

"At the close of our last social meeting I was asked if I had seen any trace of organization in the globules of the Vibrio-like fibrillæ of the muscle of Sagitta. My answer was in the negative. No longer ago than yesterday I was fortunate in discovering the origin of another form, or rather of several forms, of these pseudo-animate bodies, called Infusoria. Whilst watching the decomposition of the inner wall of the proboscis of a young *Aurelia flavidula*, our common jelly-fish, I observed that the whole component mass of cells was in violent agitation, each cell danced zigzag about within the plane of the wall. If any one will shake about a single layer of shot in a flat pan, he can obtain an approximate idea of the appearance of this moving mass. In a perfectly healthy condition these cells lie closely side by side, and do not move individually from place to place, but yet are active on one side, which constitutes the surface of the stomach, where they are covered by vibratile ciliæ. As the young Aurelia grows, this wall becomes separated from the outer one, but not completely, for the cells of the two adhere to each other by elongated processes, varying in number from one to six or seven. Each cell of the inner wall contains numerous red or brown granules, a few transparent globules, and a single large, clear mesoblast.

"When decomposition ensued, these cells became still further separated from each other, and danced about in the manner which I have just described. The vibratile ciliæ were not observed to share in this movement; in fact, I could not detect their presence, because, no doubt, they had become decomposed and fallen away; but the elongated processes, which heretofore had remained immovable and stiff, lashed about with very marked effect upon the cells to which they belonged, and caused them to change place constantly. At last the inner wall fell to pieces, and every cell moved independently and in any direction. If at this time they were placed before the eyes of Ehrenberg, or any one of his adherents, he would at once pronounce every cell with a single process a *Monas;* the red or brown granules would be recognized as the stomachs filled with food, the transparent globules as the empty stomachs, and the large mesoblast as the genital organ, or propagative apparatus. Those with two processes would be to him a *Chilomonas*, or some other genus closely related to it; those with three or four on one side would be the *Oxyrrhis* of Dujardin; and those with six or seven processes, the *Hexamita* of the same author.

"To complete the apparently truthful determinations of these microscopists, I would only have to place before them some of these cells which I have found in a state of self-division, each half possessing its genital-like mesoblast. In all their various shapes and actions, and in the mode of self-division, there is a remarkable and undistinguishable resemblance to numerous moving bodies which go under the name of Infusoria, and which may be found, unconnected with any living organism, in various kinds of infusions."

The character of these movements being discussed, Mr. Clark remarked, that he was disposed to attribute them to endo-exosmotic action.

Mr. Folsom read an extract from some philological notes, containing the results of an investigation he had recently been called on to make for an immediate practical end, in reference to lexicography. The subject was the common English words *Turtle* and *Tortoise*, their origin and history, and especially their complication with each other in modern use.

"This has been an occasion of perplexity to English lexicographers; but it does not appear that the subject has ever been historically investigated, or that it has yet engaged the attention of those philologists who, in England and in this country, are now so intent on tracing the pedigree, and exhibiting the successive changes in the meaning, of the words that make up our composite language. Whoever attempts to investigate it may well take for his motto the Greek proverb that will presently have to be cited.

"There is no difficulty as to the word *turtle* in itself, for it has always been applied to the bird from whose note it was originally taken; *toor* * representing it in Hebrew, *toortoor* (among other names) in Arabic, and *turtur* in Latin. Beautiful changes are rung upon it, as it passes into the languages derived from the Latin. *Tortorella*, *tourterelle*, *tórtola*, and other sweet diminutives, are heard in the Italian, French, and Spanish tongues. In Anglo-Saxon it was slightly modified into *turtel*, which form it also bears in other languages of the same

* וְקוֹל הַתּוֹר, "and the voice of the turtle."

stock.* But it is important here to remark, that in none of these languages is the word *turtel* ever applied to *any other animal than the bird.* As an Anglo-Saxon element, it kept its place in the English of Chaucer and Wickliffe in the fourteenth century; it has come down to us with its original meaning; and, until comparatively late times, it has borne no other.

"The word *tortoise* is not so readily disposed of. Whatever be its derivation, it seems to have no affinity with any word in Anglo-Saxon or any other Teutonic language; nor is it found at all in the earliest English writers. Indeed, neither the Anglo-Saxon nor early English exhibits any distinctive name for this order of reptiles; which is doubtless to be accounted for by the fact, that the tortoise is not indigenous to Great Britain,† and in early times was not familiarly known there. It is hardly so known even at the present day; for the land-tortoise is imported from the Continent, to be kept enclosed in gardens, and the sea-tortoise from the West Indies, as a special luxury for the rich in great cities.

"What, then, was the earliest word applied to this animal by Englishmen who had occasion to see it abroad? Sir John Mandeville, who died in 1372, and is generally regarded as the earliest English prose writer, may answer the question. In his book of 'Travels in the East' he says, 'And yee schulle undirstonde that I have put this bok out of Latyn into Frensche, and translated it agen out of Frensche into Englyssche, that *every man of my nation may understonde it.*' (p. 5.) Now, where he speaks of the island of Java, in his Latin book he uses these words: 'Sunt in hoc territorio *testudines terribilis quantitatis,* fitque de majoribus regi ac nobilibus delicatus ac pretiosus cibus: mentior si non quasdam ibidem viderim *testudinum conchas* in quarum unâ se tres homines occultarent.' In his French version it is, 'Il y a aussi dans ce païs *des tortuës d'une énorme grandeur,*' &c. And in his English translation he says, 'There ben also in that contree, a *kynde of snayles,* that ben so grete that many persones may loggen hem in here schelles,' &c.

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* In these it is prefixed to some derivative from the Gothic *dubo,* dove, making a Latin and Gothic compound, like *turtle-dove* in English. The Gothic itself, the oldest Northern source of English, does not exhibit the word *turtel* in the few written monuments of it that are extant; but, for "turtle-doves" (Luke ii. 24), it has "hraiva-dubono," mourning doves.

† See Bell's "History of British Reptiles," p. 16.

"Another instance, belonging to a period hardly later than the fourteenth century, appears in a treatise on the Art of War, in which the *testudo*, the Roman military contrivance used in attacking walled towns, is thus described: 'They had also all manere of gynes [engines] .... that nedful is [in] taking or seging of castel or of citee, as *snayles*, that was nought else but .... targetis, under the which men, when they foughten, were heled [protected], ... as the *snayl* is in his house; therefore they clepid them *snayles*.' *

"It would seem, therefore, that *snail* (Anglo-Saxon *snægel*) was, in the state of our language at that time, of necessity used to embrace also the tortoise, as a creeping thing covered with a shell.† This comprehensive meaning was inserted in the earliest dictionaries (English-Latin), and, through the conservatism of lexicographers, has been kept in all subsequent dictionaries of the kind, down to the present day.‡ That this meaning had not quite died out of literature at the close of the seventeenth century, is evident from more than one example. Howell, for instance, in 1660, says that 'Apelles used to paint a good housewife upon a *snayl*,' to intimate that she should be silent and 'home-keeping.' Dryden, in 1693, has an unequivocal passage in the Dedication of his translation of Juvenal. He says, that 'When he had once enjoyned himself so hard a task, he then considered the Greek proverb, Ἤδει χελώνης κρέα φαγεῖν, ἢ μὴ φαγεῖν, § that he must either eat the whole *snail*, or let it quite alone'; — no great feat surely, if a modern snail were meant.

"If, then, the word *tortoise* was not a denizen of the English language in the time of Mandeville, when did it first make its appearance, and from what quarter?

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* As quoted by Halliwell from a manuscript.

† A precisely analogous case is afforded in the word *worm*, which in Anglo-Saxon and early English comprehended also *serpents*; and Cædmon, in his paraphrase of Scripture, makes Eve listen to the *wyrmes geweaht*, "counsel of the worm" (Milton's "false worm"). So Shakspeare's "mortal worm," and "the pretty worm of Nilus" on the breast of Cleopatra. A trace of this use still lingers in modern English, in the name of the *blind-worm* or *slow-worm*, which passes for a serpent.

‡ Barret's "Alvearie" (1575), as re-edited by Fleming in 1580: "SNAILE, limax, *testudo*, cochlea." So Rider, Gouldmann, Littleton, Holyoke, and Ainsworth (even in the latest editions). And Minshew, in his Spanish Dictionary (1617), has "GALÁPAGO, tortoise, *snail*."

§ A gastronomic precept, preserved in Athenæus, which passed into a proverb, like Pope's "Drink deep, or taste not."

"Among the earliest names conferred by Columbus, in his first voyage, on islands in the West Indies, was *Tortuga*; * and the abundance and enormous size of the sea-tortoises there, and the supply of food they furnished to the mariners and first settlers, caused them to figure afterwards in the Spanish accounts of their transactions in the New World.

In 1554, on the solemn entry into London of Philip the Second and Queen Mary, just after their marriage, Richard Eden, transported, as he says, by the magnificence of the scene, determined to make his countrymen acquainted with the exploits of Spain in the New World, and immediately translated the 'Decades' of Peter Martyr, and Oviedo's 'Natural History of the Indies,' which, in one volume, he presented to Philip and Mary in 1555. This book contains, probably, the first printed account in the English language of the West Indian *tortoise*, and furnishes the earliest use of the word to which this investigation has led.† Where Oviedo says, 'En la ysla de Cuba se hallan tan grandes *tortugas* que diez y quinze hombres son necesarios para sacar del agua una dellas,' Eden translates thus: 'In the island of Cuba we found great TORTOYSES (*which are certain shell-fishes*) of such byggenesse that ten or fifteene men are scarcely able to lift one of them out of the water.' The explanatory words, inserted by the translator in a parenthesis for the benefit of English readers, seem to show that the term was either wholly new to the language, and coined by

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* Spanish etymologists are not agreed on the origin of this word, early applied to the Mediterranean tortoise on the coast of Spain. (See Cobarruvias.) It is commonly referred, with the Italian *tartaruga* and the French *tortue*, to the Latin *tortus*, as importing the *crookedness* of the animal's legs. (See Diez, Etym. Wörterbuch.)

Afterwards the Spanish also gave their name of the land-tortoise (*galápago*) to a group of islands off the Western coast of America, abounding in gigantic animals of the sort. Spanish etymologists consider this word as belonging to the Arabic portion of their language; and from it came, through sailors, our name denoting the upper shell, *callipash* (at first written, *nauticè*, "galley patch"), softened by the French into *carapace* (which English naturalists now begin to adopt), and further transformed into *carapax, -acis,* as a Latin noun of the third declension, by a French naturalist, to enrich, as he says, that language for the use of his brethren.— *Callipee*, which is found used as early as 1657, by Lygon in his "History of Barbados," seems to be a word coined by cooks in the West Indies, as a convenient counterpart to *callipash,* to distinguish the under from the upper shell:—"Lifting up his belly, which we call his *callipee*."

† Thirty years earlier than Richardson's earliest citation, which purports to contain the earliest instance known to him.

him for the occasion from the Spanish word, or, what is more probable, that he had heard it from the seamen of that day, with whom it is known he associated,* and who had caught it from Spanish sailors, and modified it with a sailor's usual license.†

"However this may have been, *tortoise* appears as the English name, and the only one, in all the original narratives of the great series of English voyages to the West Indies, which began shortly after the publication of Eden's book, and lasted to the end of the century.‡

"Nor was it long confined to seamen's narratives. In 1576 it was adopted by Abraham Fleming, in his translation of Ælian's 'Various History,' as the rendering of χελώνη; in 1580 it appears in Barret's Latin-English Dictionary; great writers of Elizabeth's reign — Bacon, Shakspeare, and others — gave it general currency with their royal stamp; in 1611 it was set in the English Bible; and all English writers since, whether in literature or science, have continued to use it as the 'plain English' word for *testudo*,§ and the only one comprising all kinds of testudinous animals.

"In the early part of the seventeenth century, however, a new name for the marine tortoise of America makes its appearance in some of the sea narratives of that day. In 1602 Captain Bartholomew

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* Sebastian Cabot, who was still living when Eden wrote, was one of them, and he had been in the West Indies.

† The plural *tortugas*, rapidly uttered, has a near resemblance in sound. It is worthy of note that where seamen under Sir Walter Raleigh's command write "tortoyses egges," he, the accomplished scholar, always writes "tortugas egges," and *tortoise* does not appear in his own narratives.

‡ Published in Hakluyt's Collection (1600). In the narrative of the second of these voyages to America (that of Hawkins, in 1564–65), written by John Sparke, who was in it, we have, probably, the first printed English account, by an *English eyewitness*, of the sea-tortoise of the West Indies. "Certain islands of sand, called the Tortugas. .... These islands bear the name of Tortoises, because of the number of them which there do breed, whose nature is to live both in the water and upon land also, but breed only upon the shore, in making a great pit, wherein they lay egges, to the number of 300 or 400, and covering them with sand, they are hatched by the heat of the sunne; and by this means cometh the great increase. Of these we took very great ones, which have both back and belly all of bone, of the thickness of an inch; the fish whereof we proved, eating much like veale; and finding a number of egges in them, tasted also of them, but they did eat very sweetly." — Hakl. III. 610.

§ "*Testudo, lacerta*, ... in plain English *tortoise, lizard*." — Dr. John Mason Good (1812), in his Lectures before the Surrey Institution.

Gosnold made his voyage, so memorable in the history of New England, to the shores of Massachusetts. Gabriel Archer, one of his companions, wrote an account of it. In this he says, 'I commanded some of my companie to seeke out for crabbes, lobsters, TURTLES, &c., for sustayning us till the ship's return.' He uses the same word in one other passage. In these two passages we have probably the first occurrence in print of the word *turtle* with this application. But John Brereton, another of the same ship's company, who also wrote an account of the voyage, addressed to Sir Walter Raleigh, does not use it, and speaks of the 'whales, *tortoises*, both on land and sea, seales, cods,' &c. *Tortoise* alone is found in the accounts of voyages to America immediately afterwards; viz. in Gilbert's to Virginia (1603), Waymouth's to Penobscot (1605), and Nicol's to the West Indies (1605).* But in 1610 *turtle* recurs in two independent narratives† of the wreck of an English ship at Bermuda, in consequence of which a company of English gentlemen and sailors, bound to Virginia, were detained on this hitherto uninhabited island for nine months. One of the narrators, William Strachey, who was one of the company, writes: 'Then the tortoyses came in. .... The tortoyse is reasonable toothsom (some say) wholesome meate. .... One *turtle* (*for so we called them*) feasted six messes. .... We should find five hundred [eggs] .... in

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* These, and the subsequent accounts of English intercourse with America, before 1625, are found in Purchas's Pilgrims, printed in that year. But Purchas, speaking in his own person, uniformly adheres to "tortoise." — In tracing the history of a word, one must resort to original writers. Captain Southey, in his "Chronological History of the West Indies" (1827), quotes substantially these early voyagers, but, with the habitude of a modern sailor, in more than one instance he substitutes for *tortoise* another name, unknown in their day; and the remarkably accurate Dr. Holmes, in his "Annals of America," *once* (under 1593) lapses into the anachronism of "turtle-fat" for "oil of tortoises." Perhaps he was put off his guard by having become familiar with this compound term during several years' residence, in early life, near the coast of Georgia.

† Memorable for their effect on Shakspeare's imagination when he created Prospero's Island. — The Spanish pronunciation of the name of Juan *Bermudez*, the first discoverer of the island where the English ship was wrecked, is exactly represented in Shakspeare's "still-vexed *Bermoothes*" (the *th* being soft); which accounts for the uncouth appearance of the name. Neither this, nor the corrupted form Bermud*as*, has any plurality in it. The first boy born in the wrecked community was christened *Bermudas*, from which a feminine was made for the first-born girl, *Bermuda*.

the opening of a shee *turtle*. .... At the day appointed of nature .... there creepeth out a multitude of tortoyses, as it were pismires out of an ant-hill.'

"The writer of the other narrative, Sylvester Jourdan (likewise of the company), says: 'There are also great store of tortoses (which *some call turtles*), and them so great,' &c. 'The tortose itself is all very good meate. .... We carried away with us a good portion of tortoyse oil.'

"In 1612 appeared a further account of Bermuda, a colony having now been planted there, the second English colony in the New World, and the first insular one. In it occurs this passage: '*Turkles* [sic] there be of mighty bigness. One *turkle* will serve or suffice three or four score at a meal, especially if it be a shee *turkle*.'

In 1622 Richard Norwood published a still later account of this colony, in which he says: 'Of two particulars .... I will speak. The first shall bee the tortoyse, which *they call a turtle*.* .... And, first, of the TURCKLE [sic]. .... They are like to fowle in respect to the small-

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* Why did they give it this new name? No aboriginal name appears to resemble it (though *tourebé*, the Abnaki word for *tortue*, according to Father Rasles, and "*torope*, or little turtle," used in 1613 by Whittaker, a minister in the Virginia colony, may point to the source of *terrapin*). Was it not, then, a direct waggish transfer of the name of the bird which is proverbial for conjugal tenderness and fidelity to these briny monsters, as observed by sailors in their pairing-time? The ludicrousness of the contrast will only heighten the probability to those who have been conversant with sailors, especially in boating excursions for purposes of Natural History. A turn for the ludicrous is always apt to show itself in the names they bestow on objects new to them. Even their own rude play they call "sky-larking"; and it was in a "light-horseman" that Captain Gosnold's people, in 1602, brought off to their ship probably the first *turtles* on record. "We went in our *light-horseman* from this island [Cuttyhunk] to the main [near the site of New Bedford]," where the natives gave them "furres, tobacco, *turtles*," &c. — The tortoise seems always to have been, in one way or another, associated with birds, now for some contrast, and again for some striking resemblance. "Testudo volat" was the Roman proverb for an impossibility; yet we now know, from the highest living authority on such subjects, that the sea-tortoise does, in fact, literally *fly* through the water, having in its fore extremities true wings, as to the bony structure and the mode of action. In their manners, too, testudinous reptiles present both a contrast and a resemblance to birds. Though they have not "billing and cooing," they are not without "a voice" and certain endearing ways. "Professor Jeffries Wyman had once the rare opportunity of watching two *chrysemys picta* [not, however, sea-tortoises] while making love, and he saw the male patting and caress-

ness and fashion of their heads and neckes, which are wrinkled like a *turkeyes*, but white, and not so sharp-billed. They also breed their young of the egges which they lay. .... They are very wittie. .... Shortlie after their coming in, the male and female couple, which *wee call cooting*;* this they continue some three days together, during which time they will scarce separate, though a boat come to them, nor hardly when they are smitten. .... The shee turckle comes up by night upon some sandie bay. They are easily taken .... when they are *cooting*.'

"As Virginia, Massachusetts, and other parts of the continent, and various West-India islands, were successively colonized by Englishmen, the use of the words *turtle* and *turkle* spread with the colonists, the form *turkle* taking that precedence in the common speech † of New England and the middle colonies, which it holds to this day; while *turtle*,

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ing the head of the female with its fore feet for several minutes." — Agassiz, Contributions, &c. I. 300.

It might at first be supposed that sailors could be little acquainted with the habits of the turtle-dove; but it is a singular fact that the early voyagers to America, from the beginning, speak of the turtle, or turtle-dove, as among the birds they most commonly met with, and it frequently figures on the same page, and sometimes in the same sentence, with the tortoise. Spanish voyagers early bestowed their name for this bird on the West-India island, *Tortola*.

* Here, also, there is probably allusion to a bird which is prominently mentioned in these Bermuda narratives. See the accounts of the Common Coot in Wilson's and other books on ornithology, particularly as to their manner of assembling to breed near the shore, but not on it. Indeed, they can hardly be said to live on *dry* land. The word *cooting* is not registered in Dictionaries, but it is found afterwards in use in the West Indies ("*Cooting-time*," Hughes's History of Barbadoes, 1750); and in the Fauna of Georgia, at this day, there are counted among the tortoises four different kinds of "*cooters*." (White's "Statistics of Georgia," 1849.)

† Rarely, however, found in books. Wood, in his "New England's Prospect" (1639), thus celebrates the wealth of Massachusetts Bay: —

> "The luscious lobster, with the cod-fish raw,
> The brinish oyster, muscle, periwigge,
> The *tortoise*, sought by the Indian squaw," &c.;

and Cotton Mather ("Christian Philosopher," 1721), born and bred here, never departs from the old use, though "his Essays are not altogether destitute of *American* communications."

But Josselyn, in his "New-England Rarities" (1673), says, that, among the "fishes" here, he found the "tortoise, torteise, tortuga, tortisse, *turcle*, or *turtle*, of divers kinds." *Turkle* soon became a confirmed spoken provincialism among the less educated, and was applied alike to all tortoises, in spite of the Bible and com-prevailing at the South and in the British West Indies, got into English books of voyages and travels in those parts. The word, however, with the meaning in question, did not appear in any dictionary till 1671, when Skinner's 'Etymologicon' gave this account of it: 'Nautæ etiam testudines marinas *turtles* vocant.'*

"About the middle of the last century the marine animal itself began to be imported into London, as a luxury for the table, under its West-Indian name, which then took a place in the language of the market and the kitchen; turtle-feasts were instituted; † and *turtler* came to be heard, as well as *whaler*. Polite literature sported with it in light essays and satirical verses on the manners of the town,‡ but ignored it in any other relation. Dr. Johnson, in his Dictionary, published in

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mon-school books. *Turkle* would seem to be nearly as old a name as *turtle*; and, if it had prevailed in print to the exclusion of the latter, it would have had less ambiguity.

* It must not be supposed, however, that all sailors at all times employed this word. Dampier (1679), in the narrative of his cruising in the West-India seas with a fleet of privateers under "Captain Wright, Captain Yanky," and others, and of his subsequent voyage round the world, which contributed so much to the natural history of those days, uses the two words indiscriminately, "green tortoise," "green turtle," and, in the same breath, "*turtle-doves* and sea-turtle." Defoe (1719), versed in such narratives (which he counterfeited to the life), in order to be understood by everybody, makes Robinson Crusoe begin by finding "a large tortoise or turtle. This was the first I had seen." All afterwards were *turtles*. Our Marblehead Robinson Crusoe, Philip Ashton, whose interesting narrative (1722) has just been found and published by Colonel Swett, had, at the island of Roatan, "no knife or instrument of iron by which to cut up a *tortoise*, when he had turned it." Even resident *natives* of the West Indies, at this day, do not hesitate to write thus: "By far the greater part of the sea and land *tortoises* exposed for sale in our markets come from the Main."—Verteuil's "Trinidad," &c., 1858 (dedicated to his countrymen).

† These novel feasts attracted so much notice in 1753–54, that they were repeatedly chronicled, among grave matters, in the "Historical Department" of the Gentleman's Magazine; e.g. "Saturday, July 13 [1754]. The Right Hon. Lord Anson made a present to the gentlemen of White's Chocolate House of a turtle, which weighed three hundred pounds weight, and which laid five eggs since in their possession."

‡ Lord Lyttleton, in his "Dialogues of the Dead" (1751), makes Apicius (who had just got intelligence from a freshly-arrived London alderman) tantalize, with an account of the new-found luxury, another London epicure who had come below in 1738, several years too soon. In 1753 appeared a Number of "The World," containing a humorous description of a turtle-feast at the house of a returned

1755, humorously disposed of it thus: 'Turtle; 1. A species of dove. 2. It is used among sailors and gluttons for a tortoise'*; to which Mason, in his 'Supplement,' replies in earnest: 'This assertion is not even true; for the appellation of turtle *does not extend to tortoises in general.* If all the land-men who call a sea-tortoise a turtle are therefore gluttons, everybody who understands the word must incur the imputation.'

"But, notwithstanding Johnson's disparagement, it was destined to win its way into the halls of Science. Just before this time it had begun to be introduced into formal treatises on Natural History, as a convenient subordinate name for the sea-tortoise. Hill (who had recently been at a famous turtle-feast at the London Tavern), adopted it in his 'History of Animals,' printed in 1752. Catesby (who had lived much in America) says (1754): 'The sea-tortoise is by our sailors vulgarly called *turtle*, whereof there are four different kinds.' Goldsmith, in his 'Earth and Animated Nature' (1774), writes: 'Tortoises are usually divided into those that live upon land, and those that subsist in the water; and use has made a distinction even in the name, the one being called tortoises and the other turtles.' Martyn, in 1785, in his 'New Dictionary of Natural History,' has this article: '*Turtle;* an appellation by which the moderns express that kind of tortoise which is found only in the sea, or on its shores.' And with this restricted meaning it has continued to appear, in Encyclopædias, in Transactions of learned societies, and in separate works on Natural History, down to the present day. When it is so used, neither ludi-

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West-India "nabob," and headed with the punning motto (highly relished at the time from the novelty of the subject, and famous since in the annals of wit): —

"Dapibus supremi
Grata *testudo* Jovis." — HOR.

In 1764 Christopher Smart thus translated Phædrus, with a hit at contemporary manners: —

"An eagle on a tortoise fell,
Then, mounting, bore him by his shell."

The crow proposes a wise method of getting at the meat.

"The eagle follows her behest,
Then *feasts on turtle* with his guest." —
["Magistræ largè divisit dapem."]

* Dr. Campbell, great adept as he was in the use of English, seems to have first learned the existence of this use from Johnson's Dictionary. — Philosophy of Rhetoric.

crous nor homely associations can any longer adhere to it. The science that adopts it, dignifies it for the occasion. Its progress to a post so respectable has been *slow*, it is true; but that post is at last attained; and it would now seem that lexicographers need not be at a loss how to treat this and the related word in accordance with the present state of the English language."*

Professor W. B. Rogers spoke of the estimates which had been made of the probable thickness of the earth's crust, based on the rate at which the temperature increases from the surface downwards; and he remarked that recent experiments tend to show that the crust must be much thicker than had been supposed. Bunsen, especially, has shown that the fusing point of some substances is greatly raised by pressure; but this has been demonstrated only in the case of certain substances, and could not be true of all; ice being a well-known exception, melting, as it does, under

* Present "national use" (see Campbell) is well illustrated by the two following examples, one from each side of the Atlantic, and both belonging to the present year.

Mr. Francis T. Buckland, in his just published "Curiosities of Natural History," says: "Not long ago I met a man in Oxford Street who was wheeling along a truck full of tortoises of different sizes. He said he had bought them as a speculation, from the captain of a ship then in the Victoria Docks, who had got a cargo of them. In order to get customers, he assured the passers-by that they were capital things to 'keep the kitchen clear of black beetles.' This was simply untrue, for this kind of tortoise is purely a vegetable eater. .... I bought the largest of the lot, and took him home on the top of an omnibus. The driver had evidently not had a zoölogical education, for he could not make out the nature of my prize at all. After patiently listening to my lecture on tortoises in general, he relapsed into silence," &c. (pp. 395, 396.) Glance at the next page, and the word "suffers a sea-change" at once: "A few weeks ago, when on my way to see the great iron ship opposite Greenwich, a boy got into the steamer at London Bridge, carrying a *turtle* on his back. .... He told me his business was to fetch turtle from London, when wanted for one of the hotels at Greenwich," &c. (p. 397.)

The cis-*Atlantic* example is furnished by one who, while a "chorded shell" is reposing on his left hand, writes thus with the other: "A turtle — which means a tortoise — is fond of his shell; but if you put a live coal on his back, he crawls out of it. So the boys say." The animal that New-England boys have to do with possesses the more perfect type of the order to which it belongs; and a local idiom is here translated for the benefit of the entire belt of English readers that now encircles the earth.

pressure in glaciers at a temperature below 32°. He thought the same might be the case with other crystalline bodies; and if true of granite, the earth's crust must be much thinner than is generally supposed. So that, at present, all the current estimates of the thickness of the earth's solid crust must be very uncertain.

Professor Felton (through Mr. Goodwin) communicated a continuation of his paper upon the Modern Greek language.

"I desire to add to the remarks submitted by me at a former meeting, on the pronunciation of the Greek language, a few observations, by way of illustrating its present condition, and the manner in which it adapts itself to the wants of modern society. When we consider that the earliest monuments of the Greek language, which belong to a period dating at least a thousand years before Christ, are of such perfection as necessarily implies a long previous cultivation, and that the language has been spoken and written uninterruptedly through all changes, social, religious, and political, down to the present day, and that all these changes act directly upon language, as the organ of human thought, we naturally expect corresponding changes in the forms and construction and pronunciation of the language. Dividing all this extent of time in a general way, and without any attempt at precision, we may say that there are three great periods: the first, that of the Ancient Classical Greek; the second, the Byzantine Greek; and the third, the Modern Greek. The period of the Ancient Greek would last as long as the forms of the ancient inflections and the constructions of the ancient syntax continued to be used in literature and society. The Byzantine form of the Greek, as its name indicates, would embrace those modifications of the language which were gradually introduced during the time of the Roman domination and the Byzantine Empire, and the ecclesiastical Greek. The Modern Greek may be considered as embracing those modifications of the language gradually introduced among the people in the Middle Ages, sometimes called the Romaic, and the improvements made upon that basis by the scholars of the last half-century, forming the cultivated language of the present Greeks. This, however, is a very crude arrangement. In point of fact, the Ancient Greek not only had a variety of contemporary dialects, but underwent great changes from age to age.

From Homer to the Attic Tragedians, every age had its peculiarities. From the Attic Tragedians to the Alexandrian period; from the Alexandrian period to the establishment of Christianity and the Byzantine Empire; through all the mutations of culture and thought during the long existence of that empire, down to the time of the Crusades; from that time to the capture of Constantinople by the Turks, and the subjection of the Greeks to the dominion of the Sultan; during the three centuries and a half of Turkish oppression, — the language was constantly adapting itself to the condition of the times, but it remained essentially Greek. Of the Modern, as well as of the Ancient Greek, there were many contemporary varieties spoken by the inhabitants of the Ægean Islands, the Asiatic coasts, and the Phanar in Constantinople, by the Rayas of Thrace, Macedonia, Epirus, and Thessaly, and by the population of Central and Southern Greece and of the Ionian Islands. The dialects of some of the islands, to adopt Mr. Clyde's statement, were more or less corrupted with the Italian; those of Asia Minor, Thrace, Thessaly, Bœotia, and Attica were corrupted with the Turkish; the dialects of Macedonia, Epirus, and Peloponnesus were corrupted with the Slavonic. This division is not to be taken as exact. Many Turkish words obtained a general currency throughout Greece, and the same may be said of some Slavonic and Italian words and phrases.

"When, towards the close of the last century, a revival of the spirit of nationality in the Greek race commenced, the literary men, with Coray at their head, began the systematic improvement and purification of the language. In this process three courses were suggested: first, to adopt the Modern or Romaic as it then existed; second, to restore the Ancient Greek; third, to purify the Modern from its corruptions, to retain its inflections and syntax, and to supply its deficiencies from the treasure-house of the Ancient Greek. The last of these three courses was seen to be the best, and was favored and supported by the ablest men. Turkish, Italian, and Slavonic words were expelled from the language, and the vocabulary has been enlarged to meet the necessities and demands of the present age, by taking pure Ancient Greek words, and by making new compounds out of old Hellenic roots. This process has gone steadily on for half a century, and the language now established in Greece, taught in the schools, written in the newspapers and literary journals, spoken in the legislative halls, the courts of justice, the pulpit, the professor's chair, and in the educated society of Athens, is pure Greek, though greatly modified, and this has been especially called the Νεο-Ἑλληνική, or New-Hellenic. The process above alluded to has not essentially changed the character of the language: even the broken dialects of the Romaic spoken by the rudest and most ignorant mountaineers were substantially Greek, and those forms of the Romaic found in the Klephtic poems are marked by poetical beauties of no common order. The New-Hellenic, as now employed by writers and speakers, has already proved itself adequate to every form of literary composition, whether in poetry or prose. The works of Soutsos, Rangabes, Orphanides, and others, have shown that it is capable of all the varieties of rhythmical combination exhibited by any other modern language. They all depend upon accent, as in the other modern languages.

"The greatest change, perhaps, is in the application of the language in adapting it to the modern cast of thought; in doing which, it has been found necessary to make out of ancient elements new words, which, though not classical, are easily understood by the classical scholar, or by using classical words with secondary or analogical meanings. This process I propose to illustrate by a few examples taken from recent books, journals, advertisements, public notices, and from the signs of the shops in the streets of Athens.

"There is still a struggle, in some cases, between the common and the classical. The traveller who steps into a shop, wishing to buy an umbrella, and asks for a σκιάδειον, may be told that the shopkeeper has no such article, though he sees the very thing in the window; and when he points it out, the seller exclaims, Ὀμπρέλλα! ὀμπρέλλα! If, wishing a flannel under-waistcoat, he asks classically for a χειτώνιον, he is likely enough to hear of *fanella*. Asking for a cup of ὕδωρ, it will be given to him under the name of νερό. And so on.

Some of the signs are as follows: —

Ὑποδηματοποιός, *Shoemaker.*

Κατάστημα Εὐρωπαικῶν φορεμάτων, *Shop* (or establishment) *for European clothing.*

Γαλακτοπωλεῖον, ὁ Πάν, *Milk-shop, the Pan.*

Σαμπανία τῆς πρώτης ποιότητος, *Champagne of the first quality.* (Spelled on the sign, however, πιότητος, which has the same pronunciation, but would mean *drinkability,* — a mistake perhaps made on purpose.)

Ἐμπορορράπτης, *Merchant-tailor.*

Ἰχθυοπωλεῖον, *Fish-market.*

Ὀπωροπωλεῖον, *Fruit-market.*

From Newspapers.

Εἰδοποίησις τοῖς συνδρομηταῖς, *Notice to subscribers.*

Ἡ συνδρομὴ προπληρωτέα, *Subscription to be paid in advance.*

Ὁ ὑπεύθυνος συντάκτης, *The responsible editor.*

Τυπογραφεῖον, *Printing-office.*

Notices, Advertisements, &c.

Ἀγγελία τοῦ Λεξικοῦ, &c., *Advertisement of the Lexicon.*

Πυρασφαλιστικὴ Ἑταιρία, ὁ Φοῖνιξ, *The Phœnix Fire Insurance Company.*

Ἀτμοπλοϊκὴ Ἑταιρία, *Steamboat Company.*

Ἑλληνικὴ ἀτμόπλοια, *Greek steam-navigation.*

Ἀτμοπλοϊκὴ συγκοινωνία μεταξὺ Πειραιῶς καὶ τῶν παραλίων τῆς Πελοποννήσου, *Steam communication between Peiræus and the coast of Peloponnesus.*

Judicial Process.

Alexander Soutsos, the famous writer, has been lately prosecuted for a libel on the government. The trial is reported in a paper, called the Ἥλιος (Sun), conducted by the poet's brother. From this report I select a few words and phrases. The accused was found guilty.

The *verdict of guilty* is καταδικαστικὴ ἐτυμηγορία.

Counsel for defence, δικήγοροι τῆς ὑπερασπίσεως.

Drawing the Jury, ἡ κλήρωσις τῶν ἐνόρκων.

The Prosecution challenged (such and such persons), ἡ Εἰσαγγελία ἐξῄρεσεν.

The indictment, τὸ ἐγκλητήριον.

My client, ὁ πελάτης μου.

Gentlemen of the Jury, Ἄνδρες ἔνορκοι.

Retire to your room, ἀποχωρήσατε εἰς τὸ δωμάτιον.

In the course of the trial the judge called one of the lawyers to order: *Keep to your subject, Mr. Counsellor,* περιορίσθητι εἰς τὸ θέμα, κύριε δικήγορε.

In Legislation.

The House of Deputies, in Athens, is called βουλή; the Senate, γερουσία. The ancient ἐκκλησία, the popular assembly, has, from early times, been appropriated to the Church.

Deputies are βουλευταί; *Senators*, γερουσιασταί. In the legislature of the Ionian Islands, the *representatives* are ἀντιπρόσωποι; as, in a recent discussion on the question of union with Greece, ὁ ἀντιπρόσωπος τῆς Λευκάδος, Κύριος Ἰωάννης Μαρῖνος ἀνήγγειλεν αὐτήν, *the representative of Leucadia reported it.*

From the report: Ἑνδεκαμελὴς ἐπιτροπὴ ἐκλεχθήσεται, *a committee of eleven members shall be chosen;* the subject to be referred to them being a διακήρυξις περὶ ἑνώσεως, *a proclamation concerning union.*

A tariff bill has been recently discussed in the legislature at Athens. From the debate I select a few terms and phrases appropriate to this subject: —

Τὸ προστατευτικὸν σύστημα, *the protective system.*

Οἱ προστατευτικοί, *the protectionists.*

Ἐλευθερία τοῦ ἐμπορίου, *freedom of trade.*

Ἐλευθέρα ἐμπορεία, *free trade.*

Πάγιος δασμός, *a fixed duty.*

Αἱ συζητήσεις περὶ τοῦ νέου νόμου τῶν σιτηρῶν τοῦ καταργοῦντος τὴν κλίμακα, *The debates on the new Corn-law abolishing the sliding-scale.*

Τὸ ζήτημα ἐτέθη εἰς ψηφοφορίαν, *the question was put to the vote.*

Ἡ τροπολογία ἀπερρίφθη, *the amendment was rejected.*

The debate on the Telegraph Bill is called Ἡ συζήτησις τοῦ περὶ τηλεγράφου νομοσχεδίου.

"One or two more illustrations must suffice. In their Declaration of Independence, in 1821, the Greeks did not employ the old term, αὐτονομία, which expresses nearly the idea, but a modern compound, ἀνεξαρτησία, resembling in its etymology our word *independence*, which to an ancient Greek would have meant *the not hanging from* something. The modern abstraction, *nationality*, is expressed by ἐθνικότης; and *national*, by ἐθνικός.

"A few years ago, when table-tipping was spreading over Europe, it visited Athens also. There is an amusing article on the subject in the Almanac for 1854, from which I take the following pleasant account of a table which imprudently disclosed the age of a lady who was present: —

"'Καὶ μόνον ἂν ἐκινεῖτο καὶ ἂν περιεπάτει! ἀλλ' ἡ ἀνατροφή της φαίνεται ὁσημέραι τελειοποιουμένη. Ὅθεν ἤδη καὶ ὁμιλεῖ καὶ γράφει, καὶ ἀριθμεῖ, καὶ ψάλλει, καὶ χορεύει! Μεθ' ὅλων δὲ τούτων τῶν γυναικείων προτερημάτων δὲν εἶν' ἀπηλλαγμένη καί τινων τῶν προπετῶς ὑπὸ τῶν ἀνδρῶν ὀνομασθέντων γυναικείων ἐλαττωμάτων. Εἶναι, φέρ' εἰπεῖν, λάλος καὶ ἀδιάκριτος, καὶ τῆς γλώσσης, ἢ μᾶλλον τοῦ ποδὸς, οὐ κρατοῦσα. Οὕτως εἰς ἑσπερινήν ποτε συναναστροφήν, ἀφ' οὗ πολλὰ ἐρωτηθεῖσα ἀπήντησε πρὸς κοινὸν θαυμασμὸν καὶ κοινὴν διασκέδασιν, ἐρωτήθη τέλος καὶ περὶ τῆς ἡλικίας κυρίας τινὸς ἐκ τῶν παρευρισκομένων. Ἡ πονηρὰ τράπεζα ἤγειρε μετὰ πολλῆς κομψότητος τὸν ἕνα της πόδα, καὶ ἤρχισε κτυπῶσα ἐλαφρῶς τὸ ἔδαφος, πρὸς μεγίστην χαρὰν ἁπάντων, καὶ τῆς κυρίας πρὸ πάντων, ἥτις ἔβλεπεν ἑαυτὴν ἀντικείμενον τῆς κοινῆς προσοχῆς. Καὶ ἐκτύπησεν ἕν, δύο, πέντε, δέκα, καὶ ἡ κυρία ἐγέλα· δεκαπέντε, δεκαεπτά· καὶ ἐγέλα πάντοτε. Ἀλλ' ἡ τράπεζα ἐξηκολούθει, καὶ αἱ ὀφρῦς τῆς κυρίας ἤρχισαν νὰ συστέλλωνται. Ἐκτύπησεν εἴκοσι, εἰκοσιέν, καὶ αἱ χεῖρες τῆς κυρίας ἐτάθησαν· εἰκοσιδύο, εἰκοσιτρία, εἰκοσιπέντε, καὶ ἡ κυρία μεθ' ὅλης τῆς δυνάμεώς της ἐβάρυνεν ἐπὶ τῆς τραπέζης· ἀλλὰ τὸ ἀφωρισμένον σκεῦος ἐξηκολούθει ἀνένδοτον, εἰκοσιοκτώ, εἰκοσιεννέα, τριάκοντα· καὶ τὸν τελευταῖον αὐτὸν ἀριθμὸν ἐκτύπησε μὲ μεγάλην σφοδρότητα, ὡς κυροῦσα αὐτοῦ τὴν ἀλήθειαν. Συγχρόνως δὲ ἡ προδοθεῖσα τριακοντοῦτις νεᾶνις ἔπεσεν ἀφ' ἑτέρου ὑπτία καὶ λειποθυμοῦσα, καὶ πάντες ὡμολόγησαν ὅτι τὰ πειράματα τῶν τραπεζῶν εἰσὶν ἐπικίνδυνα, ὡς προσβάλλοντα τὸ νευρικὸν σύστημα.'

"'If it only would move and walk about! But its education seems to be improving every day. It already talks and writes, and counts and sings and dances. But with all these feminine accomplishments, it is not free from some of what are impertinently called by men feminine faults. For example, it is talkative, thoughtless, and unable to govern its tongue, or rather its foot. Thus, at an evening party once, after it had answered many interrogatories to the general wonder and diversion, it was finally questioned about the age of one of the ladies present. The mischievous table, with much grace, raised one of its feet, and began striking the floor lightly, to the very great gratification of all, and especially of the lady, who saw herself the subject of general attention. It struck one, two, five, ten, and the lady laughed; fifteen, seventeen, and she continued to laugh. But the table kept on, and the lady's eyebrows began to contract. It struck twenty, twenty-one, and the lady held up her hands; twenty-two, twenty-three, twenty-five, and the lady pressed down on the table with all her might; but the cursed piece of furniture continued obstinately, twenty-eight, twenty-nine, thirty; and it struck the last number with great force, in confirmation of its truth. But on the other hand, at the same moment, the betrayed thirty-years-old young lady fell backwards in a fainting fit, and all confessed that the experiments of the tables are dangerous, as affecting the nervous system.'

"These illustrations might be indefinitely extended. They show the direction in which the internal changes of the language are making. Some of these new terms are made strictly according to analogy; others not so happily; but usage soon establishes them. The Greek language is a wonderful phenomenon. It stands alone in the history of human speech, like the wonderful race which first created and still preserves it."

Four hundred and sixty-seventh meeting.

May 24, 1859. — ANNUAL MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from the Librarian of the Royal University of Bonn, November 25, 1858; Société de Géographie, Paris, November 20, 1858; Académie Royale des Sciences à Amsterdam, December 20, 1858; Königlich Sächsische Bergakademie zu Freiberg (Sachsen), November 20, 1858; K. L. C. Akademie der Naturforscher, Jena, November 13, 1858; Académie Royale des Sciences de Stockholm, November 15, 1858; and the Société Imperiale des Sciences Naturelles de Cherbourg, September 1, 1858, acknowledging the receipt of the Academy's publications; — from the Académie Royale des Sciences de Stockholm, November 15, 1858, and the War Department, Washington, May 5, presenting their publications; — from the K. Preussische Akademie der Wissenschaften, August 12, 1858, acknowledging the receipt of the Academy's publications, and presenting its own; — and from the K. Bayerische Akademie der Wissenschaften, December 28, 1858, acknowledging the receipt of the Academy's publications, and asking that missing numbers may be supplied.

The Treasurer presented his annual report upon the finances of the Academy, which was ordered to be entered in full upon the record-book.

Professor Lovering, in behalf of the Committee of Publication, and Dr. A. A. Gould, from the Committee on the Library, severally presented their annual reports.

The Council submitted nominations for one Foreign Honorary Member, and three Associate Fellows; also a general report upon the actual state of the Academy, with notices of the members deceased during the past year, as follows: —

The following changes have occurred in the *personelle* of the Academy since the last Annual Meeting.

Nine members have been elected, to wit: seven Resident Fellows, one Associate Fellow, and one Foreign Honorary Member.

The Foreign Honorary Member, Professor LINDLEY, was chosen to fill the vacancy in Class II. Section 2, occasioned by the death of Mr. Brown.

The Associate Fellow, SIR WILLIAM E. LOGAN, the Government Geologist of Canada, belongs to Class II. Section 1.

Of the seven Resident Fellows, two belong to the First, three to the Second, and two to the Third Class.

Three Resident Fellows, one Associate Fellow, and four Foreign Honorary Members have deceased during the past year; in all eight, or one less than the accessions.

The Resident Fellows lost from our ranks are WILLIAM CRANCH BOND, of Class I. Section 2; DR. ICHABOD NICHOLS, of Class III. Section 1; and WILLIAM H. PRESCOTT, of Class III. Section 3.

The Associate Fellow is Professor PARKER CLEAVELAND, of Class I. Section 3.

The Foreign Honorary Members are BARON HUMBOLDT, MANUEL JOHN JOHNSON, ROBERT BROWN, and JOHANNES MÜLLER.

The Academy will observe that, although this list of its members recently deceased is not remarkably numerous, yet it mainly consists of most illustrious names.

The eulogies pronounced upon the distinguished historian and the eminent astronomer, who were almost simultaneously removed from our immediate ranks, are still fresh in our remembrance. The remaining name is that of an accomplished scholar and divine, whose age and infirm health had prevented his attendance at our meetings since his residence in this vicinity.

Our late Associate Fellow, Professor CLEAVELAND, of Bowdoin College, died at Brunswick in October last, at the age of seventy-eight years. He was graduated at Harvard College in 1799, where he became a Tutor in 1803. Two years afterwards he was appointed Professor of Mathematics, Natural Philosophy, Chemistry, and Mineralogy in Bowdoin College, the whole duties of which chair he performed until the year 1828, when he was relieved from the Mathematics, and with this exception until the year of his death, a period of more than half a century. Although somewhat later in the field than Maclure, Gibbs, and Silliman, and although he gave place in later years to Shepard and Dana, yet Professor Cleaveland may well be called the father of American Mineralogy. His celebrated Treatise on Mineralogy and Geology, published in 1816, and in a second and enlarged edition in 1822, gave a great impulse to the study of those sciences in this country, and made for him a deservedly high reputation, both at home and abroad. That he did not follow up a career of such promise by the original researches and authorship for which his talents and his great and various knowledge eminently fitted him, must be explained by his devotion to the immediate interests of the institution with which he was identified almost from its foundation, and by his conscientious absorption in the duties of his triple or quadruple professorial office, each department of which he is known to have filled with signal ability and faithfulness. Something may also be attributed to his temperament, and to his singularly stationary habits. He is said never to have entered a railroad carriage, and rarely any other vehicular conveyance.

Considering that Professor Cleaveland made no appearance before the public during the last thirty years, it may be noted to the credit for discernment of the officers of the Smithsonian Institution, and as a just recognition of the services of a pioneer in American science, that our lamented associate was chosen one of the first and very few honorary members of that Institution.

The four names which now disappear from the list of our surviving Foreign Honorary Members represent so many great lights of science lately extinguished; two of them, Müller and Johnson, ere they had attained their full meridian.

Johannes Müller, who was perhaps universally regarded as the most eminent physiologist of the present era, died on the 28th of April, 1858, therefore nearly a month before our last anniversary; but the melancholy tidings had not then reached us. Though old in fame, he was still comparatively young in years, having barely reached the age of fifty-seven.

Manuel John Johnson, the late Director of the Radcliffe Observatory, Oxford, was, by a disease of the heart, suddenly removed from the scene of his important labors, on the 28th day of February last. He was elected a Foreign Honorary Member of this Academy only about two years before; and, from his early death, it has happened that his name does not appear upon any published list of our actual members. Educated at Addiscombe, Mr. Johnson entered the Royal Artillery in the year 1821, and it was while stationed on military duty at St. Helena that his taste and talent for astronomical observation unfolded. Here his leisure, during a residence of ten years, was turned to good account in collecting materials for his St. Helena Catalogue of the mean places of six hundred and six principal fixed stars of the Southern Hemisphere, which was published in 1835; a work which, from its sharp accuracy, won for its author at once an enviable reputation. On his return to England he was entered, at a later age than is common, at Magdalen Hall, Oxford; and in 1839, immediately upon taking his degree, he received the appointment of Radcliffe Observer, and began the labors which have raised the Radcliffe Observatory to its present high rank. Established in this favorable position, he immediately commenced his principal scientific undertaking, the determination, upon a regular and most judicious plan, of the places of the close circumpolar and the chief northern stars, as far as to the 45th degree of declination. This undertaking he consistently and most persistently carried out, for nineteen years, in each of which a volume of his "Radcliffe Observations" promptly made its appearance. This work was virtually finished, and its value is everywhere recognized from the portions which have long been in use. It only remained to crown the whole by the combination of all the results into a sytematic catalogue. Even this was well-nigh done; and the first proofs of the volume which was to embody this consummation lay before him, when his hand was suddenly arrested by death.

In his employment of the heliometer, — the most complex of astronomical instruments; in the choice and plan of his investigations; in the refinement of his methods and the rigorous exactness of his observations; in the soundness of his judgment; and, not least, in the conscientious faithfulness and patience with which he assumed and endured such unremitting toil, without making, and without expecting to make, any brilliant discoveries,—he is thought to have manifested the best qualities of the practical astronomer, and to have secured a high place in the annals of the science. Personally, Johnson is said to have been strongly marked in the simplicity and independence of his character, and most attractive by his frankness, geniality, and the full and hearty co-operation which he loved to extend to all his fellow-astronomers.

The two remaining names represent stars of the very first magnitude, which, as they pass from the field of sight on the completion of a long and illustrious course, leave no equals behind them.

Beyond the immediate pale of science, and the circle of its most devoted cultivators, this association of the names of HUMBOLDT and BROWN may seem new and strange; — the one, a name familiar to the whole civilized world; the other, hardly known to a large portion of his educated countrymen. Yet these names stand together, in the highest place, upon the rolls of almost every Academy of Science in the world; and the common judgment of those competent to pronounce it will undoubtedly be, that although these vacant places upon those honorable rolls may be occupied, they will not be *filled*, in this, perhaps not in several generations.

Upon the death of ROBERT BROWN, which occurred on the 10th of June last, in his eighty-fifth year, it was remarked that, next to Humboldt, his name adorned the honorary list of a greater number of scientific societies than that of any other naturalist or philosopher. It was Humboldt himself who, many years ago, saluted Brown with the appellation of *Botanicorum facile Princeps;* and the universal consent of botanists recognized and confirmed the title. However the meed of merit in science should be divided between the most profound, and the most active and prolific minds, — between those who *divine* and those who *elaborate*, — it will probably be conceded by all, that no one since Linnæus has brought such rare sagacity to bear upon the structure, and especially upon the ordinal characters and natural affinities of plants, as did Robert Brown. True, he was fortunate in his time and his opportunities. Men of great genius, happily, often are, or appear to be, through their power of turning opportunities to good account. The whole herbaria of Sir Joseph Banks, and the great collections which he himself made around the coast of Australia, in Flinders's expedition, and which he was able to investigate upon the spot during the four years devoted to this exploration, opportunely placed in

Brown's able hands as it were the vegetation of a new world, as rich as it was peculiar, — just at the time, too, when the immortal work of Jussieu had begun to be appreciated, and the European and other ordinary forms of vegetation had begun to be understood in their natural relations. The new, various, and singular types which render the botany of New Holland so unlike all other, Mr. Brown had to compare among themselves, — to unravel their intricacies with scarcely a clew to guide him, except that which his own genius enabled him to construct in the process of the research, — and to bring them harmoniously into the general system of botanical natural alliance as then understood, and as he was himself enabled to ascertain and display it. It was the wonderful sagacity and insight which he evinced in these investigations, which, soon after his return from Australia, revealed the master mind in botanical science, and erelong gave him the position of almost unchallenged eminence, which he retained, as if without effort, for more than half a century.

The common observer must wonder at this general recognition, during an era of great names and unequalled activity, of a claim so rarely, and as it were so reluctantly, asserted. For brief and comparatively few — alas! how much fewer than they should have been! — are Mr. Brown's publications. Much the largest of them is the Prodromus of the Flora of New Holland, issued fifty years ago, which begins upon the one hundred and forty-fifth page, and which stopped short at the end of the first volume. The others are special papers, mostly of small bulk, devoted to the consideration of a particular plant, or a particular group or small collection of plants. But their simple titles seldom foreshow the full import of their contents. Brown delighted to rise from a special case to high and wide generalizations; and was apt to draw most important and always irresistible conclusions from some small, selected data, or particular point of structure, which to ordinary apprehension would appear wholly inadequate to the purpose. He had unequalled skill in finding decisive instances. So all his discoveries, so simply and quietly announced, and all his notes and observations, sedulously reduced to the briefest expression, are fertile far beyond the reader's expectation. Cautious to excess, never suggesting a theory until he had thoroughly weighed all the available objections to it, and never propounding a view which he did not know how to prove, perhaps no naturalist ever taught so much in writing so little, or made so few statements that had to be recalled, or even recast; and of no one can there be a stronger regret that he did not publish more.

With this character of mind, and while carefully sounding his way along the deep places of a science the philosophy and grounds of which were forming, day by day, under his own and a few contemporary hands, Brown could not have been a voluminous writer. He could never have undertaken a *Systema Regni Vegetabilis*, content to do his best at the moment, and to take upon trust what he had not the means or the time to verify, — like his contemporary, DeCandolle, who may worthily be compared with Brown for genius, and contrasted with him for the enthusiastic devotion which constantly impelled him to publication, and to lifelong, unselected, herculean labor, over all the field, for the general good.

Nor could Brown ever be brought to undertake a *Genera Plantarum*, like that of Jussieu; although his favorable and leisurely position, his vast knowledge, his keen discrimination, and his most compact mode of expression, especially indicated him for the task. Evidently, his influence upon the progress of Botany might have been greater, or at least more immediate and more conspicuous. Yet, rightly to estimate that influence now, we have only to compare the *Genera Plantarum* of Endlicher with that of Jussieu, — separated as they are by the half-century which coincided with Brown's career, — and mark how largely the points of difference between the two, so far as they represent inquiry, and genuine advancement in the knowledge of floral structure, actually originated with him. Still, after making due allowance for a mind as scrupulous and cautious as it was clear and profound, also for an unusually retiring disposition, which even in authorship seems to have rendered him as sedulous to avoid publicity as most writers are to gain it, it must be acknowledged that his retentiveness was excessive; and that his guarded published statements sometimes appear as if intended — like the anagrams of the older mathematicians and philosophers — rather to record his knowledge than to reveal it. But this was probably only in appearance, and rather to be attributed to his sensitive regard for entire accuracy, and his extreme dislike of all parade of knowledge, — to the same peculiarity which everywhere led him to condense announcements of great consequence into short paragraphs or foot-notes, and to insert the most important facts in parentheses, which he who runs over the page may read, indeed, but which only the most learned and the most reflecting will be apt to comprehend. In candor it must be said, that his long career has left some room for the complaint that he did not feel bound to exert fully and continuously all his matchless gifts in behalf of the science of which he was the most authoritative expositor.

But if thus in some sense unjust to himself and to his high calling, Brown could never be charged with the slightest injustice to any fellow-laborer. He was scrupulously careful, even solicitous, of the rights and claims of others; and in tracing the history of any discovery in which he had himself borne a part, he was sure to award to each one concerned his full due. If not always communicative, he was kind and considerate to all. To adopt the words of one of his intimate associates, "those who knew him as a man will bear unanimous testimony to the unvarying simplicity, truthfulness, and benevolence of his character," as well as to "the singular uprightness of his judgment."

The remaining, and the most illustrious name of all, — and one in its wide renown strongly in contrast with the last, — has only just now been inscribed upon our obituary list.

The telegraph of the last week brought to us the painful intelligence that the patriarch of science, the universal HUMBOLDT, died at Berlin on the 6th of May. Born in 1769, a year more prolific in great men than any equal period of all preceding time,* Humboldt had, before the end of the eighteenth century, exhibited qualities of the very highest order, and obtained a place of acknowledged celebrity in Europe. This, however, was the mere prelude to his career, for with the close of that century he commenced, with Bonpland, his wonderful exploration of Spanish America, which continued during five years. This journey must be considered in all future time as, substantially, the scientific discovery of Spanish America; and whether we measure its results by the amount of knowledge through the wide fields of Astronomy, Geography, Geology, Mineralogy, Meteorology, Zoölogy, Botany, and Political Economy, or the personal qualities by which this knowledge was collected and reduced to its place in the

* Napoleon, Wellington, Mehemet Ali, Soult, Lannes, Ney, Castlereagh, Chateaubriand, Cuvier, and Humboldt.

records of science, we cannot hesitate to place the expedition as amongst the most important and successful ever executed by man.

On his return to Europe, in 1805, Humboldt was employed several years in reducing his immense collection of materials to form for publication. From that time to his death, a period of almost half a century, he resided (except for a short time, in which he made his journey to Northern Asia) in Europe, mostly in France and Germany. The last twelve or fifteen years of this great man were principally employed in the production of his *Cosmos*, — the crowning labor of his long life, the harvest of his mature wisdom, — a work that could not have been produced by any other man, simply because no other man possessed the treasures, or a key to the treasures, of the various knowledge contained in it.

From his return to Europe to his death, he possessed, indisputably, the first place amongst philosophers, for the vast extent of his acquirements. Without doubt, at all times during the present century there have been men much greater than Humboldt in each special department of science, but no one to compare with him in the number of subjects in which he had but few superiors, — no one who could, like him, bring all the sciences into one field of view, and compare them as one whole, through their relations and dependences. It was probably this extent of knowledge that led him to generalization rather than particular discovery; to trace connections and relations, rather than to search for new and minute facts or particular laws; to produce the Cosmos, rather than discover the atomic theory or the cellular formation of organic structures. Many other men have been masters of several specialties. Humboldt alone brought the whole range of the physical and natural sciences into one specialty.

We cannot close this brief notice of the character and career of our illustrious associate without one moment's allusion to his amiable moral nature, his love of justice, and his superiority to all merely personal ends. So strong was his desire to give the influence of his high scientific position to the cause of civilization and the progress of knowledge, by assisting all applicants for his opinion and advice upon scientific subjects, that he permitted a correspondence to be extorted from him which in his last days became a load too great to be borne, and compelled a cry for relief that had hardly subsided when the news of his death reached us.

Such is the faint outline of a man whose name is indelibly written with those who have been most eminent in this wonderful age of scientific activity. The Academy claims the privilege, in common with the learned societies with which he was associated throughout the civilized world, to express its sorrow for his death, and to offer its tribute of honor to his memory.

The Academy now consists of

153 Resident Fellows,
78 Associate Fellows, and
71 Foreign Honorary Members.

Of the Foreign Honorary Members

26	belong to the		First Class,
26	"	"	Second Class, and
19	"	"	Third Class.

Of the Associate Fellows,

32	belong to the		First Class,
29	"	"	Second Class, and
17	"	"	Third Class.

Of the 153 Resident Fellows,

45	are	ranked	in the	First Class,
46	"	"	"	Second Class, and
62	"	"	"	Third Class.

Their distribution into the several sections need not here be detailed; for the printed list, newly revised, is just now issued.

A clause in the statute, Chap. I. § 2, makes it "the duty of this Council" "to exert its influence to obtain and preserve a due proportion in the number of Fellows in each of the Sections." In view of which, the Council venture to call attention to the fact, that the First and Second Classes of the Resident Fellows are as nearly equal as possible, while the Third Class, instead of one third, now comprises two fifths of the Resident Fellows.

Professor Agassiz then said: —

"Gentlemen, — I have been requested to present on this occasion some remarks upon the scientific career of Humboldt. So few days have elapsed since the sad news reached our shore, that I have had no time to prepare an elaborate account of that wonderful career, and I am not myself in a condition in which I could have done it, being deprived of the use of my eyes, so that I had to rely upon the hand of a friend to make a few memoranda on a slip of paper, which might enable me to present my thoughts in a somewhat regular order. But I have, since the day we heard of his death, recalled all my recollections of him; and, if you will permit me, I will present them to you as they are now vividly in my mind.

"HUMBOLDT — ALEXANDER VON HUMBOLDT as he always called himself, though he was christened with the names of FREDERICK HEINRICH ALEXANDER — was born in 1769, on the 14th of September, — in that memorable year which gave to the world those philosophers, warriors, and statesmen who have changed the face of Science and the condition of affairs in our century. It was in that year that Cuvier and Chateaubriand were also born; and among the warriors and statesmen, Napoleon and the Duke of Wellington are children of 1769; and it is certainly a year of which we can say that its children have revolutionized the world. Of the early life of Humboldt I know nothing; and I find no records, except that in his tenth year he lost his father, who had been a major in the army during the Seven Years' War, and afterwards a chamberlain to the King of Prussia. But his mother took excellent care of him, and watched over his early education. The influence she had upon his life is evident from the fact, that, notwithstanding his yearning for the sight of foreign lands, he did not begin to make active preparations for his travels during her lifetime. In the winter of 1787–88, he was sent to the University of Frankfort on the Oder, to study finances. He was to be a statesman; he was to enter high offices, for which there was a fair chance, owing to his noble birth and the patronage he could expect at the court. He remained, however, but a short time there.

"Not finding those studies to his taste, after a semester's residence in the University, we find him again at Berlin, and there in intimate friendship with Wildenow, then Professor of Botany, and who at that time possessed the greatest herbarium in existence. Botany was the first branch of natural science to which Humboldt paid especial attention. The next year he went to Göttingen, being then a youth of twenty years; and here he studied Natural History with Blumenbach, and thus had an opportunity of seeing the progress Zoölogy was making in anticipation of the great movement by which Cuvier placed that science on a new foundation. For it is an unquestionable fact, that in first presenting a classification of the animal kingdom based upon a knowledge of its structure, Blumenbach in a measure anticipated Cuvier; though it is only by an exaggeration of what Blumenbach did, that an unfair writer of later times has attempted to deprive Cuvier of the glory of having accomplished this object upon the broadest possible basis. From Göttingen he visited the Rhine, for the purpose of studying Geology, and in particular the basaltic formations of the Seven Mountains. At Mayence he became acquainted with George Forster, who proposed to accompany him on a journey to England. You may imagine what an impression the conversation of that active, impetuous, and powerful man made upon the youthful Humboldt. They went to Belgium and Holland, and thence to England, where Forster introduced him to Sir Joseph Banks. Thus the companions of Captain Cook in his first and second voyages round the world, who were already venerable in years and eminent as promoters of physical science, not yet established in the popular favor, were the early guides of Humboldt in his aspirations for scientific distinction. Yet Humboldt had a worldly career to accomplish. He was to be a statesman, and this required that he should go to the Academy of Commerce at Hamburg. He remained there five months, but could endure it no longer; and he begged so hard, that his mother allowed him to go to Freyberg and study Geology with Werner, with a view of obtaining a situation in the Administration of Mines. See what combinations of circumstances prepare him for his great career, as no other young man ever was prepared. At Freyberg he received the private instruction of Werner, the founder of Modern Geology, and he had as his fellow-student no less a man than Leopold von Buch, then a youth, to whom, at a later period, Humboldt himself dedicated one of his works, inscribing it 'To the Greatest Geologist,' as he was till the day of his recent death. From Freyberg he made frequent excursions into the Hartz and Fichtelgeberg and surrounding regions, and these excursions ended in the publication of a small work upon the Subterranean Flora of Freyberg, (*Flora Subterranea Fribergensis,*) in which he described especially those cryptogamous plants, or singular low and imperfect formations, which occur in the deep mines. But here ends his period of pupilage. In 1792 he was appointed an officer of the mines (*Oberbergmeister*). He went to Baireuth as director of the operations in those mines belonging to the Frankish Provinces of Prussia. Yet he was always wandering in every direction, seeking for information and new subjects of study. He visited Vienna, and there heard of the discoveries of Galvani, with which he made himself familiar; went to Italy and Switzerland, where he became acquainted with the then celebrated Professors Jurine and Pictet, and with the illustrious Scarpa. He also went to Jena, formed an intimate acquaintance with Schiller and Goethe, and also with Loder, with whom he studied Anatomy. From that time he began to make investigations of his own, and these investigations were in a line which he has seldom approached since, being experiments in Physiology. He turned his attention to the newly discovered power, by which he tested the activity of organic substances; and it is plain, from his manner of treating the subject, that he leaned to the idea that the chemical process going on in the living body of animals furnished a clew to the phenomena of life, if it was not life itself. This may be inferred from the title of the book published in 1797,—*Ueber die gereizte Muskel- und Nerven-fäser, mit Vermuthungen über den chemischen Process des Lebens, in Thieren und Pflanzen.* In these explanations of the phenomena we have the sources of the first impulses in a direction which has been so beneficial in advancing the true explanation of the secondary phenomena of life; but which, at the same time, in its exaggeration as it prevails now, has degenerated into the materialism of modern investigators. In that period of all-embracing activity, he began to study Astronomy. His attention was called to it by Baron von Zach, who was a prominent astronomer, and at that time was actively engaged upon astronomical investigations in Germany. He showed Humboldt to what extent Astronomy would be useful for him, in his travels, in determining the position of places, the altitude of mountains, &c.

"So prepared, Humboldt now broods over his plans of foreign travel. He has published his work on the Muscular and Nervous Fibres at the age of twenty-eight. He has lost his mother; and his mind is now inflamed with an ungovernable passion for the sight of foreign, and especially tropical lands. He goes to Paris to make preparation by securing the best astronomical, meteorological, and surveying instruments. Evidently he does not care where he shall go, for on a proposition of Lord Bristol to visit Egypt, he agrees to it. The war prevents the execution of this plan, and he enters into negotiations to accompany the projected expedition of Captain Baudin to Australia; but when Bonaparte, bent on the conquest of Egypt, started with a scientific expedition, Humboldt wishes to join it. He expects to be one of the scientific party, and to reach Egypt by way of Barbary. But all these plans failing, he goes to Spain with the view of exploring that country, and finding perhaps some means of joining the French expedition in Egypt from Spain. While in Madrid, he is so well received at the court, — a young nobleman so well instructed has access everywhere, — and he receives such encouragement from persons in high positions, that he turns his thoughts to an exploration of the Spanish Provinces of America. He receives permission not only to visit them, but instructions are given to the officers of the colonies to receive him everywhere and give him all facilities, to permit him to transport his instruments, to make astronomical and other observations, and to collect whatever he chooses; and all that only in consequence of the good impression he made when he appeared there, with no other recommendation than that of a friend who happened to be at that time Danish Minister to the Court of Madrid. But with these facilities offered to him, he sails in June, 1799, from Corunna, whence he reaches Teneriffe, makes short explorations of that island, ascending the peak, and sails straightway to America, where he lands in Cumana in the month of July, and employs the first year and a half in the exploration of the basin of the Orinoco and its connection with the Amazon. This was a journey of itself, and completed a work of scientific importance, establishing the fact that the two rivers were connected by an uninterrupted course of water. He established for the first time the fact, that there was an extensive low plain, connected by water, which circled the high table-land of Guiana. It was an important discovery in Physical Geography, because it changed the ideas about water-courses, and about the distribution of mountains and plains, in a manner which has had the most extensive influence upon the progress of Physical Geography. It may well be said that, after this exploration of the Orinoco, Physical Geography begins to appear as a part of science. From Cumana he makes a short excursion to Havana, and, hearing there of the probable arrival of Baudin on the west coast of America, starts with the intention of crossing at Panama. He arrives at Carthagena, but is prevented by the advance of the season from crossing the Isthmus, and changes his determination from want of precise information respecting Baudin's expedition. He determines to ascend the Magdalena River and visit Santa Fé de Bogotá, where, for several months, he explores the construction of the mountains, and collects plants and animals; and, in connection with his friend, Bonpland, who accompanied him from Paris, he makes those immense botanical collections which were afterwards published by Bonpland himself, and by Kunth, after Bonpland had determined on an expedition to South America. In the beginning of 1802 he reaches Quito, where, during four months, he turns his attention to everything worth investigating, ascends the Chimborazo to a height to which no human foot had reached, anywhere; and having completed this survey, and repeatedly crossed the Andes, he descends the southern slope of the continent to the shore of the Pacific at Truxillo, and, following the arid coast of Peru, he visits finally Lima. I will pass lightly over all the details of his journey, for they are only incidents in that laborious exploration of the country, which is best appreciated by a consideration of the works which were published in consequence of the immense accumulation of materials gathered during those explorations. From Lima, or rather from Callao, he sails in 1802 for Guayaquil and Acapulco, and reaches Mexico in 1803, where he makes as extensive explorations as he had made in Venezuela and the Andes, and after a stay of about a year, having put all his collections and manuscripts in order, revisits Cuba for a short time, comes to the United States, makes a hurried excursion to Philadelphia and Washington, where he is welcomed by Jefferson, and finally returns with his faithful companion Bonpland to France, accompanied by a young Spanish nobleman, Don Carlo de Montufar, who had shared his travels since his visit to Quito.

"At thirty-six years of age, Humboldt is again in Europe, with collections made in foreign lands, such as had never been brought together before. But here we meet with a singular circumstance. The German nobleman, the friend of the Prussian and Spanish Courts, chooses Paris for his residence, and remains there twenty-two years to work out the result of his scientific labor; for, since his return, with the exception of short journeys to Italy, England, and Germany, sometimes accompanying the King of Prussia, sometimes alone, or accompanied by scientific friends, he is entirely occupied in scientific labors and studies. So passes the time to the year 1827; and no doubt he was induced to make this choice of a residence by the extraordinary concourse of distinguished men in all branches of science with whom he thought he could best discuss the results of his own observations. I shall presently have something to say about the works he completed during that most laborious period of his life. I will only add now, that in 1827 he established himself in Berlin, having been urged of late by the King of Prussia again and again to return to his native land. And there he delivered a series of lectures preparatory to the publication of Cosmos; for in substance, even in form and arrangement, these lectures, of which the papers of the day gave short accounts, are a sort of prologue to the Cosmos, and a preparation for its publication.

"In 1829, already sixty years of age, he undertakes another great journey. He accepts the invitation of the Emperor Nicholas to visit the Ural Mountains, with a view of examining the gold-mines and localities where platina and diamonds had been found, to determine their geological relations. He accomplished the journey with Ehrenberg and Gustavus Rose, who published the result of their mineralogical and geological survey in a work of which he is the sole author; while Humboldt published, under the title of Asiatic Fragments of Geology and Climatology, his observations of the physical and geographical features made during that journey. But he had hardly returned to Berlin when, in consequence of the Revolution of 1830, he was sent by the King of Prussia as extraordinary ambassador to France, to honor the elevation of Louis Philippe to the throne. Humboldt had long been a personal friend of the Orleans family, and he was selected as ambassador on that occasion on account of these personal relations. From 1830 to 1848, he lived alternately in Berlin and in Paris, spending nearly half the time in Paris and half the time in Berlin, with occasional visits to England and Denmark; publishing the results of his investigations in Asia, making original investigations upon various things, and especially pressing the establishment of magnetic observatories, and connected observations all over the globe. He obtained the co-operation of the Russian government and that of the government of England; and at that time those observatories in Australia and in the Russian Empire to the borders of China were established, which have led to such important results in our knowledge of terrestrial magnetism. Since 1848, he has lived uninterruptedly in Berlin, where he published, on the anniversary of his eightieth year, a new edition of those charming first flowers of his genius, his Views of Nature, the first edition of which was published in Germany in 1808. This third edition appeared with a series of new and remodelled annotations and explanations; and that book in which he first presented his views of nature, in which he drew those vivid pictures of the physiognomy of plants, and of their geographical distribution, is now revived and brought up to the present state of science. The 'Views of Nature' is a work which Humboldt has always cherished, and to which in his Cosmos he refers more frequently than to any other work. It is no doubt because there he had expressed his deepest thoughts, his most impressive views, and even foreshadowed those intimate convictions which he never expressed, but which he desired to record in such a manner that those that can 'read between the lines' might find them there; and certainly there we find them. His aspiration has been to present to the world a picture of the physical world, from which he would exclude everything that relates to the turmoil of human society and to the ambitions of individual men. A life so full, so rich, is worth considering in every point of view, and it is most instructive to see with what devotion he pursues his work. As long as he is a student, he is really a student, and learns faithfully, and learns everything he can reach. And he continues so for twenty-three years. He is not one of those who are impatient to show that they have something in them, and with premature impatience utter their ideas, which become insuperable barriers to independent progress in later life. Slowly, and confident of his sure progress, he advances, and while he learns, he studies also independently of those who teach him. He makes his experiments, and to make them with more independence he seeks for an official position. During five years he is a business man, in a station which gives him leisure. He is Superintendent of the Mines, but a Superintendent of the Mines who can do much as he pleases; and while he is thus officially engaged journeying and superintending, he prepares himself for his independent researches. And yet it will be seen he is thirty years of age before he enters upon his American travels, those travels which must be said to have been the greatest undertaking ever carried to a successful issue, if judged by the results; they have as completely changed the basis of physical science, as the revolution which took place in France about the same time has changed the social condition of that land. Having returned from these travels to Paris, a new period of his life begins, — that of concentrated critical studies. He works up his materials then with untiring ardor and devotion; and he is not anxious to appear to have done it all himself. Oltmanns is called to his aid to revise his astronomical observations and his barometrical measurements, by which he has determined the geographical position of seven hundred different points, and the altitude of more than four hundred and fifty of them.

"The large collection of plants which Bonpland had begun to illustrate, but of which his desire of seeing the tropics again has prevented the completion, he intrusts to Kunth. He has also brought home animals of different classes, and distributes them among the most eminent zoölogists of the day. To Cuvier he intrusts the investigation of that remarkable Batrachian, the Aeolotel, the mode of development of which is still unknown, but which remains in its adult state in a condition similar to that of the tadpole or the frog during the earlier period of its life. Latreille describes the insects, and Valenciennes the shells and the fishes; but yet, to show that he might have done the work himself, he publishes a memoir on the anatomical structure of the organs of breathing in the animals he has preserved, and another upon the tropical monkeys of America, and another upon the electric properties of the electric eel. But he was chiefly occupied with investigations in Physical Geography and Climatology. The first work upon that subject is a dissertation on the geographical distribution of plants, published in 1817. Many botanists and travellers had observed, that in different parts of the world there are plants not found in others, and that there is a certain arrangement in that distribution; but Humboldt was the first to see that this distribution is connected with the temperature of the air, as well as with the altitudes of the surface on which they grow, and he systematized his researches into a general exposition of the laws by which the distribution of plants is regulated. Connected with this subject he made those extensive investigations into the mean temperature of a large number of places on the surface of the globe, which led to the drawing of the isothermal lines so important in their influence in shaping Physical Geography and giving accuracy to the mode of representing natural phenomena. Before Humboldt we had no graphic representation of complex natural phenomena which made them easily comprehensible, even to minds of moderate cultivation. He has done that in a way which has circulated information more extensively, and brought it to the apprehension more clearly, than it could have been done by any other means.

"It is not too much to say, that this mode of representing natural phenomena has made it possible to introduce in our most elementary works the broad generalizations derived from the investigations of Humboldt in South America; and that every child in our schools has his mind fed from the labors of Humboldt's brain, wherever geography is no longer taught in the old routine. Having completed his American labors, Humboldt published three works, partly connected with his investigations in America, and partly with his further studies in Europe since his return; and, among others, a book which first appeared as a paper in the *Dictionnaire des Sciences Naturelles*, but of which separate copies were printed under the title of *Essai sur la Constitution des Roches dans le deux Hemisphères.* This work has been noticed to the extent which it deserved by only one geologist, Elie de Beaumont. No other seems to have seen what there is in that paper, for there Humboldt shows for the first time, that, while organic nature is the same all the world over, — granite is granite, and basalt is basalt, and limestone and sandstone limestone and sandstone, wherever found, — there is everywhere a difference in the organized world, so that the distribution of animals and plants represents the most diversified aspects in different countries. This at once explains to us why physical sciences may make such rapid progress in new countries, while Botany and Zoölogy have to go through a long process of preparation before they can become popular in regions but recently brought under the beneficial influence of civilization. For while we need no books of our own upon Astronomy, Chemistry, Physics, and Mineralogy, we have to grope in the dark while studying our plants and animals, until the most common ones become as familiar to us as the common animals of the fields in the old countries. The distinction which exists in the material basis of scientific culture in different parts of the world is first made evident by this work. By two happily chosen words, Humboldt has presented at once the result of our knowledge in Geology at the time, in a most remarkable manner. He speaks there of 'independent formations.' Who, before Humboldt, thought there were successive periods in the history of our globe, which were independent one of the other? There was in the mind of geologists only a former and a present world. Those words expressing the thought, and expressing it in reference to the thing itself, for the first time occur in that memoir; thus putting an end to those views prevailing in Geology, according to which the age of all the rocks upon the earth can be determined by the mineralogical character of the rocks appearing at the surface. The different geological levels at which rocks belonging to the same period have been deposited, but which have been disturbed by subsequent revolutions, he happily designated as 'geological horizons.'

"It was about the time he was tracing these investigations that he made his attempt to determine the mean altitude of the continents above the sea. Thus far geographers and geologists had considered only the heights of mountain chains, and the elevation of the lower lands, while it was Humboldt who first made the distinction between mountain chains and table-lands. But the idea of estimating the average elevation of continents above the sea had not yet been entertained; and it was again Humboldt who, from the data that he could command, determined it to be at the utmost nine hundred feet, assuming all irregularities to be brought to a uniform level. His Asiatic travels gave him additional data to consider these depressions and swellings of continents, when discussing the phenomena of the depression of the Caspian Sea, which he does in a most complete manner.

"There is a fulness and richness of expression and a substantial power in his writing, which are most remarkable, but which render his style somewhat involved. He has aimed to present to others what nature presented to him, — combinations interlocked in such a complicated way as hardly to be distinguishable, and his writings present something of the kind. You see his works, page after page, running into volumes without division into chapters or heads of any sort; and so conspicuous is that peculiarity of style in his composition, that I well remember hearing Arago turning to him, while speaking of composition, and saying: 'Humboldt, you don't know how to write a book; you write without end, but that is not a book, — it is a picture without a frame.' Such an expression of one scientific man to another, without giving offence, could only come from a man so intimately associated as Arago was with Humboldt. And this leads me to a few additional remarks upon his character and social relations. Humboldt was born near the court. He was brought up in connection with courtiers and men in high positions in life. He was no doubt imbued with the prejudices of his caste. He was a nobleman of high descent. And yet the friend of kings was a bosom friend of Arago, and he was the man who could, after his return from America, refuse the highest position at the Court of Berlin, that of Minister of Public Instruction, preferring to live in a modest way in Paris, in the society of all those illustrious men who then made Paris the centre of intellectual culture. It was there that he became one of that *Société d'Arcueil*, composed of all the great men of the day, to which the paper on Isothermal Lines was presented, and by which it was printed, as all papers presented to it were, for private distribution. But from his intimate relations especially to the Court of Prussia, some insinuations have been made as to the character of Humboldt. They are as unjust as they are severe in expression. He was never a flatterer of those in power. He has shown it by taking a prominent position, in 1848, at the head of those who accompanied the victims of the Revolution of that year to their last place of rest. But while he expressed his independence in such a manner, he had the kindliest feelings for all parties. He could not offend, even by an expression, those with whom he had been associated in early life; and I have no doubt that it is to that kindliness of feeling we must ascribe his somewhat indiscriminate patronage of aspirants in science, as well as of men who were truly devoted to its highest aims. He may be said to have been, especially in his latter years, the friend of every cultivated man, wishing to lose no opportunity to do all the good of which he was capable; for he had a degree of benevolence and generosity which was unbounded. I can well say that there is not a man engaged in scientific investigations in Europe, who has not received at his hands marked tokens of his favor, and who is not under deep obligations to him. May I be permitted to tell a circumstance of this kind which is personal to me, and which shows what he was capable of doing without giving an opportunity of mentioning it. I was only twenty-four years of age when in Paris, whither I had gone with means given to me by a friend; but I was at last about to resign my studies from want of ability to meet my expenses. Professor Mitscherlich was then on a visit in Paris, and I had seen him in the morning, when he asked me what was the cause of my depressed feelings; and I told him that I had to go, for I had nothing left. The next morning, as I was seated at breakfast in front of the yard of the hotel where I lived, I saw the servant of Humboldt approach. He handed me a note, saying there was no answer, and disappeared. I opened the note, and I see it now before me as distinctly as if I held the paper in my hand. It said: —

"'My friend, I hear that you intend leaving Paris in consequence of some embarrassments. That shall not be. I wish you to remain here as long as the object for which you came is not accomplished. I enclose you a check for £50. It is a loan which you may repay when you can.'

"Some years afterwards, when I could have repaid him, I wrote, asking for the privilege of remaining for ever in his debt, knowing that this request would be more consonant to his feelings than the recovery of the money, — and I am now in his debt. What he has done for me, I know he has done for many others, in silence and unknown to the world.

"I wish I could go on to state something more of his character, his conversational powers, &c., but I feel that I am not in a condition to speak of them. I will only say, that his habits were very peculiar. He was an early riser, and yet he was seen at late hours in the saloons in different parts of Paris. From the year 1830 to 1848, while in Paris, he had been charged by the King of Prussia to send reports upon the condition of things there. He had before prepared for the King of Prussia a report on the political condition of the Spanish colonies in America, which no doubt had its influence afterwards upon the recognition of the independence of those colonies. The importance of such reports to the government of Prussia may be inferred from a perusal of his political and statistical essays upon Mexico and Cuba. It is a circumstance worth noticing, that, above all great powers, Prussia has more distinguished scientific and literary men among her diplomatists than any other state. And so was Humboldt actually a diplomatist in Paris, having been placed in that position, not from choice, but in consequence of the benevolence of the King, who desired to give him an opportunity of being in Paris as often and as long as he chose.

"But from that time there were two men in him, — the diplomatist, living in the Hotel des Princes, and the naturalist, who roomed in the Rue de la Harpe, in a modest apartment in the second story, where his scientific friends had access to him every day before seven. After that he was frequently seen working in the library of the Institute, until the time when the Grand Seigneur made his appearance at the Court or in the saloons of Paris.

"The influence he has exerted upon the progress of science is incalculable. I need only allude to the fact that the Cosmos, bringing every branch of natural science down to the comprehension of all classes of students, has been translated into the language of every civilized nation of the world, and gone through several editions. With him ends a great period in the history of science, a period to which Cuvier, Laplace, Arago, Gay-Lussac, DeCandolle, and Robert Brown belonged, and of whom only one is still living, — the venerable Biot.

"Gentlemen, I present the following resolutions for your consideration: —

"*Resolved*, That the members of the American Academy of Arts and Sciences have heard with deep sorrow of the loss the world has sustained in the recent death of their late foreign associate, the Baron Alexander von Humboldt.

"*Resolved*, That they recognize in their late associate a most illustrious example of devotion to the noblest objects and pursuits. From early life to the last days of an old age protracted far beyond the usual limit of intellectual activity, he has been vigorously and assiduously engaged in advancing, by his own labors, and by the impulse and support he has given to the labors of others, the boundaries of human knowledge. The results of his all-comprehending researches he has presented to the world in such simple and attractive forms as to render them the common property of mankind. To the loftiest gifts of intellect he has added never-failing generosity, disinterestedness, and humanity. His memory, therefore, deserves and will receive the veneration of all future ages. While we grieve that the world is deprived of the light of his presence, we rejoice that his vast powers remained undiminished to the last, and that we may pronounce his life eminently happy, since he has enjoyed, during its long course, the warmest affection of all who have known him, and has been graciously permitted to close it in the midst of the sublimest occupations, and without suffering calamity."

The resolutions were unanimously passed.

The annual election was held, and the following officers were chosen for the ensuing year: —

JACOB BIGELOW, *President.*
DANIEL TREADWELL, *Vice-President.*
ASA GRAY, *Corresponding Secretary.*
S. L. ABBOT, *Recording Secretary.*
J. P. COOKE, *Librarian.*
EDWARD WIGGLESWORTH, *Treasurer.*

Council.

J. I. Bowditch,
Joseph Lovering, } of Class I.
E. N. Horsford,

Louis Agassiz,
Jeffries Wyman, } of Class II.
J. B. S. Jackson,

James Walker,
Henry W. Torrey, } of Class III.
Robert C. Winthrop,

The Standing Committees, nominated by the President, were elected as follows: —

Rumford Committee.

EBEN N. HORSFORD, JOSEPH LOVERING,
DANIEL TREADWELL, HENRY L. EUSTIS,
MORRILL WYMAN.

Committee of Publication.

JOSEPH LOVERING, JEFFRIES WYMAN,
CORNELIUS C. FELTON.

Committee on the Library.

A. A. GOULD, W. B. ROGERS,
GEORGE P. BOND.

Committee to Audit Treasurer's Accounts.

THOMAS T. BOUVÉ, C. E. WARE.

Committee of Finance.

JACOB BIGELOW, EDWARD WIGGLESWORTH,
J. I. BOWDITCH.

M. LIOUVILLE, of Paris, was elected a Foreign Honorary Member, to fill the vacancy in Class I. Section 1 (Mathematics), caused by the death of the late M. Cauchy.

The Hon. JOHN HENRY CLIFFORD, of New Bedford, and the Hon. EMORY WASHBURN, of Cambridge, were elected Fellows, in Class III. Section 1 (Philosophy and Jurisprudence).

Professor Gray communicated (by title), —

"Characters of some New *Musci* and *Hepaticæ*, collected by Charles Wright in the North Pacific Exploring Expedition, under the command of Captain John Rodgers. By William S. Sullivant and Leo Lesquereux."

"Characters of New Algæ of the same Expedition. By Professor William H. Harvey."

DONATIONS TO THE LIBRARY.

FROM APRIL 16, 1858, TO APRIL 15, 1859.

Editors of the American Journal of Science and Arts.

Vol. L. General Index to Forty-nine Volumes. 1819 – 45. 8vo. New Haven. 1847.

Academy of Sciences, Arts, and Belles-Lettres, Dijon.

Mémoires. Années 1810, 1818, 1823, 1825 – 27, 1833, 1837 – 40, et Tome V. 2e Serie. 1856. 9 vols. 8vo. Dijon. 1810 – 40, 1856.

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Mémoires. Tome IV. 8vo. Paris et Cherbourg. 1856.

L. Nodot.

Description d'un Nouveau Genre d'Edente Fossile, renfermant plusieurs Espèces voisines du Glyptodon. Atlas. Ouvrage publié par l'Acad. des Sciences, Arts, et Belles-Lettres de Dijon. 4to. Dijon.

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Denkschriften. Phil.-Hist. Classe, Band VIII. Math.-Natur. Classe, Band XIII. 4to. Wien. 1857.

Sitzungsberichte. Math.-Natur. Classe, Band XXIII. Heft 2; XXIV. Heft. 1 und 2. Phil.-Hist. Classe, Band XXIII. Heft. 1 – 4. 8vo. Wien. 1857.

Royal Danish Academy.

Oversigt over det Kgl. Danske Videnskabernes Selskabs Forhandlinger i Aaret 1856, 1857. 8vo. Kjöbenhavn.

Skrifter 5te Række, Histor og Philos. Afdeling. 2nde Binds Forste Hefte, og 2nde Hefte. 4to. Kjöbenhavn. 1856 – 57.

Supplement aux Tables du Soleil de MM. P. A. Hansen et C. F. K. Olufsen, par P. A. Hansen. 4to pamph. Copenhague. 1857.

Royal Society of Northern Antiquaries.

Atlas de l'Archéologie du Nord, représentant des Échantillons de l'Age de Bronze et de l'Age de Fer. Publié par la Soc. Roy. des Antiq. du Nord. 1 vol. 8vo. Copenhague. 1857.

Sur la Construction des Salles dites des Géants. Par S. M. Le Roi Frederic VII. de Danemark. 8vo pamph. Copenhague. 1857.

Cabinet d'Antiquités Américaines à Copenhague. Rapport Ethnographique par C. C. Rafn. 8vo pamph. Copenhague. 1858.

Observatory of Breslau.

Grundzüge der Schlessischen Klimatologie. . . . . . Aus den von der Schlessischen Gesellschaft für vaterlandische Cultur seit dem Jahre 1836 veranlassten und einigen alteren Beobachtungsreihen ermittelt und nach den in der Jahren 1852 – 55 ausgeführten Rechnungen der Herren W. Günther, R. Büttner, und H. v. Rothkirch zusammengestelt und für den Druck vorbereitet von Dr. J. G. Galle, Director der Sternwarte. . . . . . 4to pamph. Breslau. 1857.

Hon. Charles Sumner.

United States Naval Astronomical Expedition to the Southern Hemisphere, during the Years 1849, –50, –51, –52. Vol. VI. Magnetical and Meteorological Observations under the Direction of Lieutenant J. M. Gilliss, LL. D., Superintendent. 4to. Washington. 1856. [Ex. Doc.]

Report of the Superintendent of the Coast Survey, showing the Progress of the Survey during the Year 1855. 1 vol. 4to. Washington. 1856. [Ex. Doc.]

Report of the Superintendent of the Coast Survey, showing the Progress of the Survey during the Year 1856. 1 vol. 4to. Washington. 1857. [Ex. Doc.]

Map of the Patuxent and St. Mary's Rivers, Maryland. From Surveys by Major J. J. Abert, Topographical Engineers, and Major J. Kearney, Topographical Engineers, in 1824. Washington. 1857.

Report on the United States and Mexican Boundary Survey made under the Direction of the Secretary of the Interior, by William H. Emory, Major First Cavalry and United States Commissioner. Vol. I. 4to. Washington. 1857. [Ex. Doc.]

Report of the Secretary of the Treasury on the Construction and Distribution of Weights and Measures. 1 vol. 8vo. Washington. 1857. [Ex. Doc.]

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Report of the Commissioner of Patents for the Year 1857. Arts and Manufactures. 3 vols. 8vo. Washington. 1858. [Ex. Doc.]

Report of the Commissioner of Patents for the Year 1857. Agriculture. 1 vol. 8vo. Washington. 1858. [Ex. Doc.]

Samuel Nicolson.

The Nicolson Pavement, invented by Samuel Nicolson of Boston, Mass. 8vo pamph. Boston. 1855.

Peat Coal. Its Value to the Northern and Northeastern States. 4to pamph. Boston. 1857.

Chicago Historical Society.

Illinois Geological Survey. Abstract of a Report on Illinois Coals, etc. 8vo pamph. Chicago. 1858.

Dr. Nicolas B. L. Manzini.

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Four hundred and sixty-eighth meeting.

August 9, 1859. — Stated Meeting.

The President in the chair.

The Corresponding Secretary read letters of acceptance from the Hon. John H. Clifford and the Hon. Emory Washburn, who were elected Fellows at the preceding meeting. Also letters relative to the exchanges of the Academy.

Dr. C. T. Jackson communicated the results of the examination, made by Mr. John H. Blake and himself, of the Frozen Well in Brandon, Vermont; which was examined by them on the 10th and 11th of June last, in behalf of the Boston Society of Natural History.

This well is situated about half a mile west of the Brandon Hotel, and is on the estate of Abraham Trombley. It was dug in the month of November, 1858.

After sinking through loam and sandy sub-soil twenty feet, a bed of frozen gravel, with lumps of ice, was met with, and the whole bed was frozen to the thickness of about fifteen feet. The gravel consisted of large and small pebbles, imbedded in mud, which was all frozen. Some lumps of ice, of the size of twelve-pound cannon-balls, were taken out. Below this frozen deposit, sand was struck at the depth of thirty-five feet from the surface, and three springs of water came in from below, and still supply water.

The well is regularly walled with stones, and has a cover of marble, with a circular hole eighteen inches in diameter cut through it. Over the well there is a curb with a windlass, covered with a roof to keep the rain from the rope; this covering prevents any direct radiation of heat from the surface of the water in the well. At the bottom of the well, for five feet above the water, a crust of solid ice exists, attached to the walls of the well. In the winter and early summer the surface of the water freezes over, even as late as the month of June. On measuring the depth of the well, it was found to be 35.4 feet deep, and there were 2.4 feet of water in it. The temperature of the water on the 10th and 11th of June last was $\frac{1}{2}°$ Centigrade, or 33° F., while there was a thick crust of solid ice extending to the height of five feet above the water, and closely attached to the sides of the well. A boy was sent down in the bucket, and he broke off masses of this ice with a hammer, and sent it up for us to examine.

Since ice daily forms on the sides of the well, it is evident that the temperature of the gravel-bed must be considerably below the freezing point. The liquid water which supplies the well comes from the sandy stratum below, and is warmer than the stratum which overlies it.

A lighted candle was lowered down into the well, and it continued to burn; the flame was not in any manner deflected; so there was no current of air in the well. Numerous springs and wells in every direction around the frozen well were examined, and none of them were frozen, or were remarkable for coldness of their waters.

It was thus ascertained that the frozen stratum in which Trombley's well was sunk is quite limited, and that it is confined to the gravel-bed, or to the mass of frozen drift-pebbles, which shows itself on the road-side at the Hogback, four hundred and fifty feet northwest from the well. This gravel-bed dips directly towards the frozen well, and undoubtedly is the same stratum that was dug through in sinking it.

On examining this out-crop, we saw six feet in thickness of coarse pebbles, consisting of water-worn boulders and smooth pebbles of quartz, sienite, and blue limestone. Above this was about one foot in thickness of sand, and over that about two feet of mixed sand and clay, and above this the usual sandy loam of the country. The hill rises forty-five feet from the level of the top of the well, and the land slopes towards it at an angle of six degrees, the distance being four hundred and fifty feet. Northwest from this hill, and all around it, the rocks are blue-gray compact limestone, probably of Silurian age, but destitute of fossils. On the surface of these limestone rocks are abundant drift boulders, consisting of rocks that do not occur in place in that part of Vermont. They are drift-boulders from the north. The surface of the limestone ledges is much worn by drift action, presenting the well-known appearance of *les roches moutonée* of glacial regions.

It may be premature to propose any theory to account for the facts here stated, since we intend to make more extended researches, and through the liberality of a gentleman of this city (Uriah Boyden, Esq.) we are provided with the pecuniary means. It is proposed to sink another well to the gravel-bed, at a point half-way between the out-crop at the Hogback and the present well, in order to discover the extent of the frozen ground; and this we shall do now at the close of the summer months, when the heat shall have penetrated as far as it is likely to go.

Several hypotheses have been proposed, to account for the existence of this bed of frozen gravel; such as its being, perhaps, a fossil glacier of a period of intense cold, during the drift epoch; or that the cold air of the winter months may have penetrated through even a pebble-bed; or that the longer continuance of winter cold may have caused freezing of the gravel-bed, and that the heat of our short summers has not been able to reach the ice to melt it.

The committee as yet adopt no conclusions, but are collecting the elements for a solution of the problem, and hope in due time to arrive at trustworthy results. They have procured from Mr. David Buckland, of Brandon, (one of the Smithsonian observers,) a series of thermometrical tables of observations, extending from 1853 to 1859, which will enable them to estimate the temperature of the climate for each month of those years, and the mean annual temperature.

Professor Henry, of the Smithsonian Institution, made a verbal communication relative to the application of the telegraph to the prediction of changes of the weather, particularly in the city of Boston and its vicinity.

It has been fully established by the observations which have been made under the direction of the Smithsonian Institution, and from other sources of information, that the principal disturbances of the atmosphere are not of a local character, but commence in certain regions, and are propagated in definite directions over the whole surface of the United States east of the Rocky Mountains.

From a careful study of all the phenomena of the winds of the temperate zones, it is inferred that over the whole surface of the United States and Canada there are two great currents of air continually flowing eastward. These currents consist of an upper and a lower, the former returning the air to the south which was carried by the latter towards the north. The lower current, which is continually flowing over the surface of the United States, is about two miles in depth, and moves from the southwest to northeast. The upper or return current, which is probably of nearly equal magnitude, flows from northwest to southeast, or nearly at right angles to the other, and the resultant of the two is a current almost directly from the west. The reaction of these two currents appears to be the principal cause of the sudden changes of weather in our latitude. They give definite direction to our storms, accordingly as the latter are more influenced by the motion of the one or the other of these great aerial streams. The principal American storms may, from our present knowledge, be divided into two classes; namely, those which have their origin in the Caribbean Sea, and those which enter our territory from the north, at the eastern base of the Rocky Mountains. Those of the first class, which have been studied with much success by the lamented Redfield and others, follow the general direction of the Gulf-Stream, and, overlapping the eastern portion of the United States, give rise to those violent commotions of the atmosphere which are in many instances so destructive to life and property along our eastern coast. These storms from the south are frequently two or three days in traversing the distance from Key West to Cape Race, and their approach and progress might generally be announced by telegraph in time to guard against their disastrous effects. Though the general direction of these storms appears to be made out with considerable certainty, much remains to be done in settling the theory of their character and formation.

The materials which have been collected at the Smithsonian Institution during the last seven years, relative to the other class of storms, have enabled us to establish general facts of much value, not only in a scientific point of view, but also in their application to the prediction of the weather. [This statement was verified by a series of maps, exhibited to the Academy by Professor Henry, on which were indicated the beginning and progress of some remarkable changes of weather.] From these maps it appears that the great disturbances of the atmosphere which spread over the surface of the United States enter our territory from the possessions of the Northwest Company, about the sources of the Saskatchawan, at the base of the Rocky Mountains, and are thence propagated south and east, until, in many instances, they spread over the whole of the United States, and probably a large portion of the British possessions.

For example, the great depression of temperature which occurred in January of the present year, and which will be remembered by every one as the most marked cold period of the season, entered the territory of the United States at the point before mentioned on the 5th of January, and on the 6th reached Utah, on the 7th Santa Fé, and on the 8th the Gulf of Mexico, and, passing onwards, it was felt in Guatemala on the 10th. While it was advancing southward, it was spreading over the continent to the east; on the 7th, it reached the Red River settlement, and all places under the same meridian, down to the Gulf of Mexico. It reached the meridian of Chicago on the 8th, the western part of the State of New York on the 9th, New England on the 10th, and Cape Race on the 13th. It moved with about equal velocity over the Southern States, and was observed at Bermuda on the 12th.

The remarkable frost of last June, so far as it has been traced, had the same origin, and followed the same eastward course. The fact was also illustrated by the maps before mentioned, that the warm periods which have occurred in past years have followed the same law of progression, and consequently their approach could have been announced to the inhabitants of the Eastern States several days in advance, had a proper system of telegraphic despatches been established.

The value of the telegraph in regard to meteorology has been fully proved by the experience of the Smithsonian Institution. The Morse line of telegraph has kindly furnished the Institution during the last twelve months, free of cost, with a series of daily records of the weather, from the principal stations over the whole country east of the Mississippi River and south of New York. In order to exhibit at one view the state of the weather over the portion of the United States just mentioned, a large map is pasted on a wooden surface, into which, at each station of observation, a pin is inserted, to which a card can be temporarily attached. The observations are made at about seven o'clock in the morning, and as soon as the results are received at the Institution, an assistant attaches a card to each place from which intelligence has been obtained, indicating the kind of weather at the time; — rain being indicated by a black card, cloudiness by a brown one, snow by a blue one, and clear sky by a white card.

This meteorological map is an object of great interest to the many persons from a distance who visit the Institution daily; all appear to be specially interested in knowing the condition of weather to which their friends at home are subjected at the time. But the value of the map is not confined to the gratification of this desire. It enables us to study the progress of storms, and to predict what changes in the weather may be expected at the east, from the indications furnished by places farther west. For example, if a black card is seen in the morning on the station at Cincinnati, indicating rain at that city, a rain-storm may confidently be expected at Washington at about seven o'clock in the evening. Indeed, so uniformly has this prediction been verified, that last winter the advertising in the afternoon papers of the lectures to be delivered at the Institution that evening was governed by the condition of the weather in the morning at Cincinnati, — a rainy morning at the latter inducing a postponement of the lecture.

It must be evident, from the facts given, that if a system of telegraphing over the whole country east of the Rocky Mountains were established, information could be given to the Middle and Eastern States of the approach of disturbances of the atmosphere of much value to the agriculturist, the ship-owner, and to all others who transact business affected by changes of weather, as well as of importance to the invalid and the traveller. Indeed, with a proper combination of the lines now in operation, daily intelligence might be obtained in the city of Boston which would be of the highest interest to its inhabitants. Professor Henry mentioned Boston in particular, because this city is so situated that the storms, both of the southern and western class, reach it after they have been felt in New York, and in other places which are not as far east and north. It is necessary to remark, that the same use of the telegraph is in a measure inapplicable to the inhabitants of Western Europe, since they live on the eastern side of an ocean, and cannot be apprised of the approach of storms from the west. For the same reason, the general laws of storms are more conveniently studied by the meteorologists of this country than by those of Great Britain and France.

It should be distinctly understood, that the remarks which have been made in this communication relate to the more violent changes of the weather which occur in autumn, winter, and spring. The thunder-showers which occur almost daily during the warm weather in summer have somewhat of a local character, and commence at the same time, and frequently at the same hour, for several days in succession, at the same and different places; but wherever they commence, they move eastward over the country until they are exhausted.

Professor Henry also spoke of the facts collected in regard to the nature of American storms, and their connection with the two great aerial currents continually flowing over the temperate zone. He considered that the great changes of the weather are principally due to the gradual production of an unstable equilibrium in the two currents, by the accumulation of heat and moisture in the lower.

He spoke in high terms of the importance of the labors of Mr. Espy in developing the theory of the upward motion of air, and the evolution of latent heat in the production of storms.

In reply to a question as to the possibility of crossing the Atlantic in a balloon, the Professor stated that he had little doubt, if the balloon could be made to retain the gas, and to ascend into the upper current, it would be wafted across the ocean in the course of three or four days. If it descended into the lower current, it would be carried to the north of east; and if it continued in the upper current, it would reach Europe south of the same point. The course could be changed, within certain limits, by ascending and descending from one current to the other. The late balloon voyage from St. Louis to Jefferson County, New York, was of interest in confirming the theoretical direction of the great lower current of this latitude.

The Corresponding Secretary presented the following paper upon the Mosses collected in Captain Rodgers's recent exploring voyage; which is published by permission of Captain Rodgers.

Characters of some new Musci collected by Charles Wright in the North Pacific Exploring Expedition, under the Command*

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* Of the very interesting collection of Mosses brought home by the Expedition, eighty-six were gathered in Japan and adjacent islands, and seven on the coast of China. Of these ninety-three species, the fifty-four following are identical with species occurring either in Europe or in North America, or in both countries: —

Sphagnum squarrosum, Phascum crispum, Weisia viridula, Rhabloweisia fugax, Dicranella curvata, Dicranum scoparium, Trematodon longicollis, Leucobryum glaucum, Trichostomum pallidum, T. inflexum, Barbula unguiculata, Ceratodon purpureus, Eustichium Norvegicum, Orthotrichum fastigiatum, Hedwigia ciliata, Entosthodon acuminatum, E. ericetorum, Bryum pyriforme, B. nutans, B. torquescens, B. pallescens, Mnium punctatum, Bartramia pomiformis, B. fontana ? Atrichum angustatum, Pogonatum aloides, P. alpinum, Polytrichum juniperinum, P. commune, Hypnum scitum, H. minutulum, H. Starkii, H. crassinervium, H. popu-

of Captain John Rodgers. By William S. Sullivant and Leo Lesquereux. August, 1859.

1. Fissidens laxus (sp. nov.): dioicus, perpusillus, acrocarpus, simplex; foliis 5 – 6-jugis oblongis longius acuminatis costa excurrente cuspidatis laxe areolatis, areolis hexagono-rotundis permagnis; capsula ovali leptodermi.

Hong Kong, China.

2. Fissidens incrassatus (sp. nov.): dioicus, pusillus, acrocarpus, ramosus; foliis 8 – 10-jugis oblongis lineari-oblongisve subito acuminatis dense minute areolatis, costa vix excurrente; capsula ovali-oblonga pachydermi; operculo longe rostrato; calyptra dimidiata.

On rocks at Camoens' Grotto, near Macao; also at Hong Kong, China.

3. Fissidens pungens (sp. nov.): monoicus, acrocarpus, pusillus, simplex; foliis 10 – 14-jugis anguste linearibus sensim acuminatis, costa sub apice desinente; capsula ovali rostrato-operculata; calyptra anguste conica; floribus masculis axillaribus.

On rocks in shaded ravines, Hong Kong, China.

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leum, H. salebrosum, H. velutinum, H. rutabulum, H. serpens var., H. adnatum, H. denticulatum, H. serrulatum, H. microcarpum, H. brevirostre, H. triquetrum, H. splendens, H. Oakesii, H. pratense, H. Haldanianum, H. cupressiforme var., H. polymorphum, H. cuspidatum, Hookeria lucens var.? Anomodon tristis, Pylaisæa velutina.

These species are distributed as follows: — eight occur only in Eastern North America, and six in Europe; two occur in Europe, and in Western North America; seven in Europe and in Eastern and Western North America; and thirty-one are common to both Europe and Eastern North America. Or, in other words, forty are found both in Europe and in North America; of the remaining fourteen, six are restricted to Europe, and eight to North America.

Closely allied to these fifty-four species are the twenty-four Japanese and Chinese species here characterized as new.

From these data it is apparent that the similarity of the bryology of Japan to that of Europe and North America, particularly their Western and Eastern portions respectively, is even greater than that which prevails (as recently shown by Professor Gray's admirable papers on the subject) in the Phænogamous floras of those countries; and indeed, excluding a *Hypopterygium* and a few *Macromitria*, — the latter represented by one species on the Southern Alleghany Mountains, — if all the species of the Japan collection should be found in New England, it would excite no other surprise than that they had so long escaped detection.

4. Orthotrichum Japonicum (sp. nov.): monoicum, laxe pulvinatum; foliis e basi elongato-lanceolata linearibus; capsula exserta obovata longicolla 8-striata; peristomii duplicis dentibus bigeminatis, ciliis nodoso-articulatis carinatis; calyptra campanulata multoties plicata epilosa.

On trees in shaded ravines, Hakodadi, Japan.

5. Dicranella obscura (sp. nov.): dioica, dense cæspitosa, subsimplex; foliis e basi lanceolata longissime subulatis subsecundis apice dentatis, costa percurrente; capsula ovali-cylindracea microstoma pachydermi; operculo aciculari-rostrato erecto; annulo obscuro; calyptra magna; sporis majusculis.

On steep banks near Hong Kong, China.

6. Ptychomitrium Wilsoni (sp. nov.): monoicum, cæspitosum; caulibus robustis; foliis confertis lineari-lanceolatis superne margine incrassata serratis, costa sub apice evanida; capsula elongato-ovali microstoma; operculo rectirostro; perist. dentibus subtrifidis hic illic pertusis; calyptra permagna campanulata rostrata plicata basi lobata.

On rocks and hill-sides, Simoda, Japan.

7. Trichostomum tortuloides (sp. nov.): monoicum, dense cæspitans; caulibus brevibus congesto-foliosis; foliis lineari-lanceolatis costa excurrente cuspidatis, marginibus incurvis subundulatis integerrimis; capsula cylindracea curvula; perist. dentibus modice contortis inferne nodoso-articulatis; operculo longe rostrato; calyptra longa angusta contorta.

On rocks among hills, near Simon's Town, Cape of Good Hope.

8. Mnium flagellare (sp. nov.): dioicum; caulibus simplicibus, innovationibus numerosis filiformibus erectis appresso-microphyllis infra perichæt. et perigon. oriundis; foliis caulinis ascendendo majoribus laxis erecto-patentibus oblongis elliptico-oblongisve superne duplicato-serratis dense minute rotundato-areolatis papillosis, costa percurrente; paraphysibus subclavatis: fructu non viso.

Rocks, on the summit of mountains, northeast of Hakodadi, Japan.

9. Leucobryum Boninense (sp. nov.): dioicum, subgracile; foliis lineari-lanceolatis strictiusculis superne convolutis apice serratis dorso lævibus, perichætialibus interioribus longe vaginantibus subito attenuatis; capsula obovato-oblonga strumosa; pedicello breviusculo: floribus masculis aggregatis.

Bonin Islands.

10. Macromitrium insularum (sp. nov.): dioicum, compacte cæspitans; ramis brevissimis densifoliis; foliis ligulatis acutis erecto-incurvis apice involutis, cellulis inferne lineari-oblongis subpellucidis superne rotundatis minutis carnosulis papillosis, costa cum apice desinente; capsula ovali microstoma brevipedicellata; operculo recte rostrato; calyptra mitriformi pilosissima.

On trees, Loo Choo Islands, Ousima; also Simoda, &c., Japan.

11. Macromitrium gymnostomum (sp. nov.): dioicum, tenellum, dense deplanato-cæspitans; ramis brevissimis incrassatis; foliis ligulatis acuminatis strictis erecto-patentibus inferne oblongo- superne minute rotundato-areolatis papillosis, costa sub apice evanida; capsula oblongo-ovali striata gymnostoma; operculo e basi depressa oblique aciculari-rostrato; calyptra cuculliformi plicata epilosa.

On rocks and trees, Simoda, Japan; and Ousima, one of the northern Loo Choo Islands.

12. Pogonatum Japonicum (sp. nov.): elatum; caule simplici sub perichætio innovante inferne aphyllo; foliis confertis siccitate circinato-tortilibus humidis patentissimis lineari-lanceolatis spinuloso-serratis brevius lamellosis; capsula cylindracea erecta subcurvula papillosa brevipedicellata.

Mountains northeast of Hakodadi, Japan.

13. Bryum humidulum (sp. nov.): dioicum, innovationibus gracilibus ramosum; foliis oblongo-lanceolatis sensim attenuatis costa excedente aristatis lineari-rhomboideo-areolatis superne denticulatis margine revolutis; capsula pendula elongata cylindraceo-clavata curvula late annulata; operculo magno hemisphærico papillato; peristomio normali.

Moist places among mountains, near Simon's Town, Cape of Good Hope.

14. Bryum crudoides (sp. nov.): dioicum; caule simplici; foliis ascendendo majoribus, inferioribus lanceolatis, comalibus erecto-patentibus lineari-lanceolatis acuminatis apice denticulatis areolatione lineari, costa valida evanida; capsula suberecta oblongo-elliptica brevicolla microstoma; peristomio *B. polymorphi*: flore masc. capituliformi.

Behring's Straits.

15. Bryum Wrightii (sp. nov.): monoicum vel synoicum, dense cæspitans, pusillum; caulibus ramisque perbrevibus; foliis gemmaceo-

imbricatis, comalibus lanceolatis longe acuminatis costa cuspidatis superne denticulatis laxius oblongo-areolatis marginibus anguste revolutis; capsula pendula globoso-pyriformi microstoma annulata; perist. intern. ciliis linearibus perforatis, ciliolis subnullis; operculo depresso-conico.

Arakamchetchene Island, Behring's Straits.

16. Bryum megalodictyon (sp. nov.): dioicum, pusillum; foliis erectis superne congestis oblongo-ovatis acutis concavis evanido-costatis, cellulis hexagono-oblongis amplissimis; capsula suberecta oblongo-pyriformi annulata; ciliis perist. intern. linearibus ciliolis nullis; operculo hemisphærico-conico papillato.

"On walls at the Capitol," Loo Choo Islands.

17. Bartramia inserta (sp. nov.): dioica, exigua, dense cæspitosa, luteo-viridis; foliis suberectis lineari-lanceolatis attenuatis sparse papillosis toto ambitu serratis marginibus recurvis, costa subpercurrente; capsula erecta globosa sulcata gymnostoma; operculo convexo minute conico.

On damp vertical rocks among hills, near Simon's Town, Cape of Good Hope.

18. Hypnum assurgens (sp. nov.): dioicum, homophyllum; caule arcuato-assurgente subpinnato-ramuloso eparaphylloso; foliis erecto-incurvis apertis e basi lata cordato-ovata lineari-lanceolatis papillosis apice serrulatis marginibus revolutis cellulis guttulatis opacis, costa pellucida sub apice evanida; capsula gibboso-oblonga cernua annulata; pedicello tuberculoso; operculo longirostrato; peristomio normali.

On decayed logs, shady hill-sides, Ousima, Loo Choo Islands.

19. Hypnum dispersum (sp. nov.): monoicum; caule prostrato diviso pinnato-ramuloso paraphylloso; foliis patentibus e basi late ovata subito lanceolato-attenuatis serrulatis papillosis, costa (præcipue in perichætialibus) valida sub apice evanida; capsula oblonga vel cylindracea curvula horizontali annulata; operculo convexo-conico obtuso.

On dry ground, shaded hill-sides, Simoda, Japan; and Loo Choo.

20. Hypnum oblongifolium (sp. nov.): monoicum, prostratum, subpinnatum; caulibus ramisque laxius compresso-foliosis; foliis e basi brevissima convoluto-angustata oblongis acutis apice serratis lineari-areolatis; capsula (an normali?) gibboso-ovali inclinata; operculo convexo-conico apiculato; peristomio hypnoideo.

Hong Kong, China.

21. Hypnum Simodense (sp. nov.): dioicum, vage et subpinnatim ramosum; foliis confertis concavis ovato-ellipticis subito longe filiformi-acuminatis elongato-areolatis margine recurvis, costa supra medium evanescente; capsula oblongo-ovali subæquali plagiostoma erectiuscula; operculo conico brevirostro; peristomio *H. læti*.

Simoda, Japan.

22. Hypnum macrostegium (sp. nov.): dioicum; subfastigiato-ramosum; foliis confertis e basi oblongo-ovata sensim longe acuminatis plicato-striatis serratis elongato-areolatis margine basilari recurvis, costa subpercurrente; capsula cylindraceo-ovali erecta annulata; int. perist. ciliolis subnullis; operculo conico longe rostrato.

Steep banks, among hills, near Simoda, Japan.

23. Hypnum flaccidum (sp. nov.): monoicum, prostratum, subpinnatim ramosum, laxe foliosum; foliis subbifariis horizontalibus ovato-lanceolatis sensim filiformi-acuminatis ecostatis integerrimis laxissime oblongo-areolatis; capsula oblonga vix curvula longicolla horizontali; operculo breviconico obtusato.

On banks, shaded hill-sides, Simoda, Japan.

24. Hypnum spinulosum (sp. nov.): monoicum, irregulariter subpinnatimve ramosum, arctius deplanato-foliosum; foliis divergentibus ovato-lanceolatis setiformi-attenuatis ecostatis toto ambitu serratis densius elongato-areolatis; capsula obovato-oblonga basi attenuata curvula horizontali.

Simoda, Japan.

25. Hypnum thelidictyon (sp. nov.): monoicum, vage subfastigiato-ramosum; caulibus ramisque assurgentibus compressis; foliis laxis e basi constricta oblongis sensim longius acuminatis concavis ecostatis toto margine serratis, cellulis elongatis grosse unipapillatis, alaribus utrinque 3 – 4 amplissimis vesiculiformibus; capsula minuta in pedicello lævi oblonga subpendula; operculo longissime aciculari-rostrato.

Hill-sides, Ousima: rocks in ravines, Hong Kong, China.

26. Hypnum pohliæcarpum (sp. nov.): dioicum, prostratum, parce ramosum; foliis bifariam complanatis ovato-lanceolatis brevius recte vel oblique acuminatis apice grosse serratis, cellulis linearibus, costellis binis brevissimis; capsula cylindracea longicolla vix incurva subpendula; operculo conico brevirostrato.

On steep shaded banks, Simoda, Japan.

27. Hypnum erectiusculum (sp. nov.): dioicum, subprostratum; caule vage diviso ramuloso compresso; foliis deorsum falcatis late ovato-lanceolatis acuminatis apice serrulatis dense lineari-areolatis, costellis subnullis; capsula gracili cylindracea erectiuscula annulata; operculo conico obtuso.

Hakodadi, Japan.

28. Hypnum Rodgersianum (sp. nov.): dioicum, majusculum; caule assurgente simplici vel semel diviso regulariter pinnato-ramuloso; foliis oblongo-lanceolatis acuminatis deorsum falcatis serrulatis ecostatis tenui-areolatis; capsula oblonga breviuscula turgida gibboso-incurva, sicca estriata; operculo obtuse conico.

On the ground, shady mountain sides, Katonasima, between the proper Loo Choo group and Japan.

29. Hypnum eximium (sp. nov.): monoicum, exiguum, prostratum, pinnato-ramulosum; foliis laxis bifariis oblongis ovato-oblongisve acutis ecostatis superne serratis laxius elongato-areolatis; capsula gibboso-oblonga turgida incurva subhorizontali annulata; operculo convexo-conico.

On decayed wood, mountain-sides, Bonin Islands.

30. Hypnum subalbidum (sp. nov.): monoicum, exiguum, prostratum, vage subpinnatim ramulosum; foliis compressis divergentibus oblongo-lanceolatis tenuiter acuminatis integerrimis ecostatis lineari-areolatis; capsula subovali vix curvula horizontali exannulata; operculo conico brevirostrato.

On damp decayed wood, Simoda, Japan; also Bonin Islands.

31. Hypnum Smallii (sp. nov.): dioicum, exiguum; caule prostrato subpinnatim ramuloso; foliis subcompresse imbricatis erecto-patentibus lanceolatis longe acuminatis ecostatis obsolete serrulatis, cellulis compactis angustissimis; capsula elongato-elliptico-oblonga horizontali pendulave; operculo conico rostrato.

On decayed logs, shaded hill-sides, Ousima; also Bonin Islands.

32. Hypnum Ometepense (sp. nov.): monoicum, laxe cæspitosum; caule tenui repente; ramis arcuato-erectis fasciculato-ramulosis; foliis lanceolatis acuminatis patentibus superne serratis, cellulis linearibus, costellis binis brevissimis; capsula in pedicello elongato obovato-oblonga macrostoma subpendula; operculo e basi conica tenuiter brevi-rostrato.

On bushes, summit of a mountain on the Island of Ometepe, in Lake Nicaragua.

33. Hookeria Wrightii (sp. nov.): dioicum, majusculum, prostratum, dense pinnatim ramulosum, subcompresse foliosum; foliis oblongo-ovalibus subito in acumen longum tenue flexuosum productis, marginibus infra acumen convolutis, cellulis angustissime linearibus, costis binis ad medium evanidis; capsula oblonga inæquali macrostoma inclinata; peristomio normali eciliolato; operculo convexo-conico recte rostrato; calyptra e basi mitriformi multifida longe rostrata.

Growing with *Hypnum Ometepense.*

The following paper was also presented through the Corresponding Secretary.

A Synonymic List of the Echinodermata of the Palæozoic Rocks of North America. By S. S. Lyon and S. A. Casseday.

In devoting the leisure hours of the last few months to the study of the Crinoidea of Kentucky and other of the principal Western States, we found, at the very outset, that the principal difficulty attending such researches was the entire absence of any concise summary of the labors of American palæontologists among this interesting family of fossil remains. In order to supply this deficiency, the following synonymic list was formed for our private use; but, hoping it might aid others engaged in similar studies, it was determined to offer it for publication. It embraces only the Crinoidea of the Palæozoic Rocks; as our acquaintance with those of the newer systems is necessarily exceedingly limited, owing to their imperfect development in the States to which reference has been made above. Besides, the rocks above the Permian afford comparatively few species of these organisms.

It was at first intended to divide the subcarboniferous into upper and lower; but the imperfect knowledge of the stratigraphy of the Western rocks precludes the feasibility of such a division.

These labors have been retarded, and possibly left imperfect, on account of the few facilities within our reach. Unable to command an extensive collection of authorities, we have been forced to gather here and there, in private libraries, the required information.

Some of the species recognized in the table were evidently founded upon mere fragments, which, however interesting in themselves, are wholly insufficient for characterizing species. They are enumerated, however, in order that the table may be as complete as the materials within reach would allow.

List of Palæozoic Echinodermata of North America.

ACROCRINUS, Yandell, Sill. Jour., 1855, Vol. 20, p. 135.

A. Shumardi, Yandell, Sill. Jour., 1855, Vol. 20, p. 135, with wood-cut. *Subcarboniferous.* Archimedes limestone.

A. urnæformis, Hall, Iowa, Vol. 1, p. 690, Pl. 25, fig. 9, a, b. *Subcarboniferous.* Kaskaskia limestone.

ACTINOCRINUS, Miller, 1821.

A. abnormis, Lyon, Geol. Survey of Kentucky, Vol. 3, p. 479, Pl. 4, fig. 1, a, b. *Devonian.* Beargrass Creek, Kentucky.

A. æqualis, Hall, Iowa, Vol. 1, p. 592, Pl. 11, fig. 4, a, b. *Subcarboniferous.* Burlington limestone.

A. biturbinatus, Hall, Iowa, Vol. 1, p. 616, Pl. 16, fig. 5, 6, a, b, c. *Subcarboniferous.* Keokuk limestone.

A. brevicornis, Hall, Iowa, Vol. 1, p. 571, Pl. 10, fig. 4, a, b. *Subcarboniferous.* Burlington limestone.

A. brevis, Hall, Iowa, Vol. 1, p. 567, Pl. 10, fig. 3, a, b. *Subcarboniferous.* Burlington limestone.

A. cælatus, Hall, Iowa, Vol. 1, p. 585, Pl. 10, fig. 14, a, b. *Subcarboniferous.* Burlington limestone.

A. Chrystyi, Shumard, Geol. Survey of Missouri, Part 2, p. 191, Pl. A, fig. 3. *Subcarboniferous.* *Actinocrinites*, Chrysty, Letters on Geology, Pl. 1, fig. 1, 2. Encrinital limestone.

A. concinnus, Shumard, Geol. Survey of Missouri, Part 2, p. 189, Pl. A, fig. 5. *Subcarboniferous.* Encrinital limestone.

A. corniculus, Hall, Iowa, Vol. 1, p. 566, Pl. 10, fig. 1, a – c. *Subcarboniferous.* Burlington limestone.

A. cornigerus, Hall, Iowa, Vol. 1, p. 576, Pl. 9, fig. 12, a – c. *Subcarboniferous.* Burlington limestone.

A. discoideus, Hall, Iowa, Vol. 1, p. 594, non icon. *Subcarboniferous.* Burlington limestone.

A. (Bato) eikosiadactylus, Casseday, Zeitschrift der Deutschen Geol. Gesell. Berlin, 1854, p. 238, Pl. 2, fig. 1, a – c, 3. *Subcarboniferous.* Spurgen Hill, Iowa, in the Archimedes limestone.

A. Gouldi, Hall, Iowa, Vol. 1, p. 613, Pl. 15, fig. 6, a, b. *Subcarboniferous.* Keokuk limestone.

A. (Bato) irregularis, Casseday, Zeitschrift der Deutschen Geol. Gesell., p. 240, Pl. 2, fig. 2, a – c. *Subcarboniferous.* Spurgen Hill, Iowa.

A. Konincki, Shumard, Geol. Survey of Missouri, Part 2, p. 194, Pl. A, fig. 8, a – c. *Subcarboniferous.* Encrinital limestone.

A. longirostris, Hall, Vol. 1, p. 589, Pl. 2, fig. 2, a, b, 4, c, d. *Subcarboniferous.* Burlington limestone.

A. Lowei, Hall, Iowa, Vol. 1, p. 611, Pl. 15, fig. 5, a, b. *Subcarboniferous.* Keokuk limestone.

A. minor, Hall, Iowa, Vol. 1, p. 573, non icon. *Subcarboniferous.* Burlington limestone.

A. Missouriensis, B. F. Shumard, Geol. of Missouri, Part 2, p. 190, Pl. A, fig. 4, a – c. *Subcarboniferous.* Encrinital limestone.

A. multiradiatus, B. F. Shumard, Trans. Acad. Sci. St. Louis, 1857 – 8, Vol. 1, No. 1, p. 75, Pl. 1, fig. 5. *A. multiradiatus,* Hall, Iowa, Vol. 1, p. 579, Pl. 10, fig. 9. *Subcarboniferous.* Burlington limestone.

A. multibrachiatus, Hall, Iowa, Vol. 1, p. 580, Pl. 10, fig. 10. *Subcarboniferous.* Burlington limestone.

A. (Dorycrinus) Mississippiensis, Roemer, Archiv fur naturgeschichte, Von Troschel, Jahrgang XIX., Bd. 1, 1853. *Subcarboniferous.* His genus was based merely upon the remarkably long thorns which protrude from the upper surface.

A. Nashvilliæ, Hall, Iowa, Vol. 1, p. 609, Pl. 15, fig. 4 ; Pl. 16, fig. 4, a, b ; Troost, Monograph, MSS. *Subcarboniferous.* Keokuk limestone ; White's Creek, Tennessee.

A. ornatus, Hall, Iowa, Vol. 1, p. 583, Pl. 10, fig. 12. *Subcarboniferous.* Burlington limestone.

A. parvus, B. F. Shumard, Geol. Survey of Missouri, Part 2, p. 193, Pl. A, fig. 9. *Subcarboniferous.* St. Louis limestone.

A. pentagonus, Hall, Iowa, Vol. 1, p. 579, Pl. 10, fig. 6, a, b. *Subcarboniferous.* Burlington limestone.

A. pernodosus, Hall, Iowa, Vol. 1, pp. 608, 617, Pl. 15, fig. 3, a, b ; Pl. 16, fig. 7. *Subcarboniferous.* An adult specimen of *A. verrucosus,* Hall.

A. pernodosus, var., Hall, Iowa, Vol. 1, p. 617, Pl. 16, fig. 7. *Subcarboniferous.* Keokuk limestone.

A. plumosus. *Vide* Glyptocrinus plumosus.

A. PROBOSCIDALIS, Hall, Iowa, Vol. 1, p. 584, Pl. 10, fig. 13. *Subcarboniferous.* Burlington limestone.

A. PYRAMIDATUS, Hall, Iowa, Vol. 1, p. 565, non icon. *Subcarboniferous.* Burlington limestone.

A. PYRIFORMIS, B. F. Shumard, Geol. Survey of Missouri, Part 2, p. 192, Pl. A, fig. 6, a, b. *Subcarboniferous.* Encrinital limestone.

A. RAMULOSUS, Hall, Iowa, Vol. 1, p. 615, Pl. 15, fig. 7. *Subcarboniferous.* Keokuk limestone.

A. ROTUNDUS, Yandell and Shumard, Geol. Survey of Missouri, Part 2, p. 191, Pl. A, fig. 2, a, b. See Chrysty, Letters, Pl. 1, fig. 3, 4. *Subcarboniferous.* Encrinital limestone.

A. SCULPTUS, Hall, Iowa, Vol. 1, p. 582, Pl. 10, fig. 11, a, b. *Subcarboniferous.* Burlington limestone.

A. SUBACULEATUS, Hall, Iowa, Vol. 1, p. 570, Pl. 10, fig. 2, a, b. *Subcarboniferous.* Burlington limestone.

A. SUPERLATUS, Hall, Iowa, Vol. 1, p. 572, non icon. *Subcarboniferous.* Burlington limestone.

A. SYMMETRICUS, Hall, Iowa, Vol. 1, p. 574, Pl. 10, fig. 8, a, b. *Subcarboniferous.* Burlington limestone.

A. TENUIRADIATUS, Hall, Palæont. of New York, Vol. 1, p. 18, Pl. 4, fig. 8, 9. *Silurian.* This is *Palæocystites tenuiradiatus.*

A. TRICORNIS, Hall, Iowa, Vol. 1, p. 569, non icon. *Subcarboniferous.* Burlington limestone.

A. TRINODUS, Hall, Iowa, Vol. 1, p. 575, non icon. *Subcarboniferous.* Burlington limestone.

A. TURBINATUS, Hall, Iowa, Vol. 1, p. 587, Pl. 11, fig. 1. *Subcarboniferous.* Burlington limestone.

A. TURBINATUS, var. ELEGANS, p. 588, Pl. 11, fig. 5. *Subcarboniferous.* Burlington limestone.

A. UMBROSUS, Hall, Iowa, Vol. 1, p. 590, Pl. 11, fig. 3, a, b. *Subcarboniferous.* Burlington limestone.

A. UNICORNIS, Owen and Shumard, Geol. Survey of Wisconsin, Iowa, and Minnesota, 1852, p. 593, Pl. 5, A, fig. 12, a, b. *A. unicornis,* Hall, Iowa, p. 568. *Subcarboniferous.* Burlington limestone.

A. VENTRICOSUS, Hall, Iowa, Vol. 1, p. 595, Pl. 11, fig. 6, a, b. *Subcarboniferous.* Burlington limestone.

A. VERRUCOSUS, Hall, Iowa, Vol. 1, p. 578, Pl. 10, fig. 7, a, b. *Subcarboniferous.* Probably a younger specimen of *A. pernodosus.*

A. VERNEUILIANUS, B. F. Shumard, Geol. Survey of Missouri, Part 2, p. 193, Pl. A, fig. 1, a, b. *Subcarboniferous.* Encrinital limestone.

A. YANDELLI, B. F. Shumard, Trans. Acad. Sci. St. Louis, 1857, Vol. 1, No. 1, p. 76. *Actinocrinites,* Yandell and Shumard, Contributions, p. 24, fig. 5, a, b. *Subcarboniferous.* Button-Mould Knob, Kentucky.

AGARICOCRINITES, Troost, MSS. (Sub-genus of ACTINOCRINUS, Hall, 1858.)

A. BULLATUS, Hall, Iowa, Vol. 1, p. 562, Pl. 9, fig. 11, a, b. *Subcarboniferous.* Burlington limestone.

A. STELLATUS, Hall, Iowa, Vol. 1, p. 564. *Subcarboniferous.* Burlington limestone.

A. TUBEROSUS, Hall, Iowa, Vol. 1, p. 617, Pl. 16, fig. 2, a, b, c. *A. tuberosus,* Troost, MSS., Cat. *Amphoracrinus Americanus?* Rœmer, in Bronn, Lethea, Vol. 11, p. 50, Pl. 4, fig. 15, a, b. *Subcarboniferous.* Keokuk limestone; Warsaw limestone, White's Creek, Tennessee.

A. WHITFIELDI, Hall, Iowa, Vol. 1, p. 621. *Subcarboniferous.* Keokuk limestone.

A. WORTHENI, Hall, Iowa, Vol. 1, p. 619, Pl. 16, fig. 1. *Subcarboniferous.* Keokuk and Warsaw limestone.

AGASSIZOCRINUS, Troost, MSS.; Hall, 1858, Iowa, Vol. 1, p. 684.

A. CONICUS, Hall, Iowa, Vol. 1, p. 687. *Astylocrinus lævis,* F. Rœmer. See Owen and Shumard, Rep. Wisconsin, Iowa, and Missouri, p. 597, Pl. 5, fig. 6. *Subcarboniferous.* This fossil has a wide range: it extends from Iowa to Tennessee.

A. CONSTRICTUS, Hall, Iowa, Vol. 1, p. 687, Pl. 25, fig. 10. *Subcarboniferous.* Kaskaskia limestone.

A. DACTYLIFORMIS, Hall, Iowa, Vol. 1, p. 685; Troost, MSS.; Shumard, Red River of Louisiana, p. 199. *Subcarboniferous.* Kaskaskia limestone.

A. GIBBOSUS, Hall, Iowa, Vol. 1, p. 686, Pl. 25, fig. 6, and 6, b. *Subcarboniferous.* Kaskaskia limestone.

AGELACRINUS, Vanuxem, 1842.

A. Dicksoni, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 84, Pl. 8, fig. 3, 3 a, 4, 4 a. *Silurian.* Trenton limestone.

A. Hamiltonensis, Vanuxem, Geol. 3d Dist. New York, p. 306, 158. *Devonian.* Hamilton group.

A. Kaskaskiensis, Hall, Iowa, Vol. 1, p. 696, Pl. 25, fig. 18. *Subcarboniferous.* Kaskaskia limestone.

AMYGDALOCYSTITES, Billings, 1854.

A. florealis, Billings, Canadian Journal, Vol. 2, p. 270; Survey Report, 1856, p. 289; Palæontology, Dec. III. p. 63, Pl. 6, fig. 1, a – e. *Silurian.* Trenton limestone.

A. tenuistriatus, Rep. Geol. Survey of Canada, 1857, p. 289; Canad. Journ. Vol. 2, p. 271; Palæont., Dec. III. p. 64, Pl. 6, fig. 2 a, 2 b. *Silurian.* Lower Silurian.

A. radiatus, Rep. Geol. Survey of Canada, 1857, p. 289; Canad. Journ., Vol. 2, p. 271; Palæont., Dec. III. p. 65, Pl. 6, fig. 3, a, b. *Silurian.* Trenton limestone.

APIOCYSTITES, Forbes, 1848.

A. elegans, Hall, Nat. Hist. of New York, Palæontology, Vol. 2, p. 243, Pl. 51, fig. 1 – 17. Compare *A. pentremoides*, Forbes, Mem. Geol. Soc. of Great Britain, 1848, Vol. 2, Part. 2, p. 502, Pl. 45. *Silurian.* Niagara group.

ARCHEOCIDARIS, McCoy. Echinocrinus, Volborth, 1832. Palæocidaris, Desor.

A. aculeatus, Shumard, Trans. Acad. St. Louis, Vol. 1, No. 2, 1858, p. 223. Coal measures.

A. Agassizi, Hall, Iowa, Vol. 1, p. 698, Pl. 26, fig. 1, a – d. *Subcarboniferous.* Burlington limestone.

A. biangulatus, Shumard, Trans. Acad. St. Louis, Vol. 1, Part 2, p. 224. Middle coal measures.

A. Keokuki, Hall, Iowa, Vol. 1, p. 699, Pl. 26, fig. 2, a, b. *Subcarboniferous.* Keokuk limestone.

A. megastylus, Shumard, Trans. Acad. St. Louis, Vol. 1, Part 2, p. 225. Upper coal measures.

A. Norwoodi, Hall, Iowa, Vol. 1, p. 701, Pl. 26, fig. 5, a – e. *Subcarboniferous.* Kaskaskia limestone.

A. Shumardiana, Hall, Iowa, Vol. 1, p. 699, Pl. 26, fig. 3, a – d, *Subcarboniferous.* Warsaw limestone.

A. Vermiliana, King, Per. Foss., Pl. 6, figs. 22-24; Swallow and Hahn, Trans. Acad. Nat. Sci. St. Louis, Vol. 1, No. 2, p. 180. In the Permian rocks of Kansas.

A. Wortheni, Hall, Iowa, Vol. 1, p. 700, Pl. 26, fig. 4, a-g. *Subcarboniferous.* St. Louis limestone.

ASTERIAS, Linnæus, 1748.

A. antiqua, Troost, Trans. Geol. Soc. of Pennsylvania, Vol. 1, p. 232, Pl. 10, fig. 9; 5th Rep. Geol. Tennessee, p. 58: *non* Hist. Sueci, p. 89, t. 26, f. 6. *Silurian.* Mountain limestone.

A. antiquata, Prof. Locke, Proceed. Acad. Philad., Vol. 1, p. 32. *Silurian.* Cincinnati, Ohio.

A. matutina, Hall, Palæont. N. York, Vol. 1, p. 91, Pl. 29, fig. 5, a, b. *Silurian.* Trenton limestone.

A. Sp. indet., Hall, Palæont. N. York, Vol. 1, p. 18, Pl. 4, fig. 11, a, b. *Silurian.* Chazy limestone.

A. Sp. indet., G. Graham, J. G. Anthony, and U. P. James, Sill. Jour., 2d Series, Vol. 1, p. 441, with wood-cut. *Silurian.* Cincinnati, Ohio.

ASTEROCRINUS. *Vide* Plerotocrinus.

ASTYLOCRINUS. *Vide* Agassizocrinus.

ASTROCRINITES, Conrad (non Austin).

A. pachydactylus, Conrad, in Mather, Geol. New York, p. 346, 347; Sill. Jour., 1st Series, Vol. 27, p. 363. *Silurian.* Pentamerus limestone.

ATELEOCYSTITES, Billings, 1858, Geol. Survey of Canada, Palæont., Dec. III. p. 72. *Silurian.* Lower Silurian.

A. Huxleyi, Billings, Palæont., Dec. III. p. 72. *Silurian.* Trenton limestone.

BATOCRINUS. *Vide* Actinocrinus.

CARYOCRINUS, Say, 1825, Jour. Acad. Nat. Sci. Phil., IV. 9.

C. ornatus, Hall, Palæont. New York, Vol. 2, Pl. A, 41, fig. 1, Pl. 49, fig. 1, a-z, Pl. 49 A, fig. 1, a-d. Von Buch, Uber Cystideon, Taf. 1, fig. 1-7. *Silurian.* Niagara Group.

CLOSTEROCRINUS, Hall, 1852.

C. elongatus, Hall, Palæont. New York, Vol. 2, p. 179, Pl. A, 41, fig. 2, a-f. *Silurian.* Clinton Group.

CODASTER, McCoy.

C. ALTERNATUS, Lyon, Geol. Survey of Kentucky, Vol. 3, p. 493, Pl. 3, fig. 3, a, b. *Devonian.* Beargrass Creek, Ky.

C. AMERICANUS, Shumard, Trans. Acad. St. Louis, 1858, Vol. 1, No. 2, p. 239. *Devonian.* Falls of the Ohio.

C. KENTUCKIENSIS, Shumard, l. c. Pl. 9, fig. 5. *Subcarboniferous.* See Pentremites Kentuckiensis.

C. PYRAMIDATUS, Shumard, l. c. p. 238, Pl. 9, fig. 1, a–e. *Devonian.* Beargrass Creek and Falls of the Ohio.

COMAROCYSTITES, Billings, 1854, Geol. Survey of Canada, Palæont., Dec. III. p. 61. Canad. Journ. Vol. 2, p. 269. Geol. Survey Rep., 1856, p. 288.

C. PUNCTATUS, Billings, l. c. Pl. 5. *Silurian.* Trenton limestone.

CYATHOCRINUS, Miller, 1821.

C. BULLATUS, Hall, Iowa, Vol. 1, p. 624, Pl. 28, fig. 1, a. *Subcarboniferous.* Keokuk limestone.

C. CORNUTUS, Owen and Shumard, Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 591, Pl. 5 A, fig. 8, a, b. *Subcarboniferous.* Burlington, Iowa.

C. DIVARICATUS, Hall, Iowa, Vol. 1, p. 554, Pl. 9, fig. 5. *Subcarboniferous.* Burlington limestone.

C. (?) FLOREALIS, Yandell and Shumard, Contributions, p. 24, Pl. 1, fig. 1. *Subcarboniferous.* Greyson Co., Kentucky.

C. GRAULIFERUS, Shumard, Red River, p. 199. *Subcarboniferous.*

C. INTERMEDIUS, Hall, Iowa, Vol. 1, p. 627, Pl. 28, fig. 10. *Subcarboniferous.* Keokuk limestone.

C. IOWENSIS, Owen and Shumard, Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 591, Pl. 5 A, fig. 11, a–c. *Subcarboniferous.* Burlington, Iowa.

C. MAGISTER, Hall, Iowa, Vol. 1, p. 628, Pl. 28, fig. 2, a, b, 3, a, b. *Subcarboniferous.* Keokuk limestone.

C. MALVACEUS, Hall, Iowa, Vol. 1, p. 554, Pl. 9, fig. 4, a, b. *Subcarboniferous.* Burlington limestone.

C. (?) MANIFORMIS, Yandell and Shumard, Contributions, p. 25, fig. 2. *Subcarboniferous.* Greyson Co., Kentucky.

C. PENTALOBUS, Hall, Iowa, Vol. 1, p. 687, Pl. 25, fig. 5, a, b. *Subcarboniferous.* Kaskaskia limestone.

C. PROTUBERANS, Hall, Iowa, Vol. 1, p. 626, Pl. 28, fig. 9. *Subcarboniferous.* Keokuk limestone.

C. PYRIFORMIS, Sill. Journ., 1st Series, Vol. 48, p. 314. *Silurian.* Lockport, New York.

C. RAMOSUS, (?) King, Perm. Fossils, Pl. 6, fig. 15–21. Swallow and Hahn, Rocks of Kansas, 1858, in Trans. Acad. St. Louis, p. 186. Permian rocks of Kansas.

C. ROTUNDATUS, Hall, Iowa, Vol. 1, p. 555, Pl. 9, fig. 7, a, b. *Subcarboniferous.* Burlington limestone.

C. SPURIUS, Hall, Iowa, Vol. 1, p. 625, Pl. 28, fig. 78. *Subcarboniferous.* Keokuk limestone.

C. STELLATUS, Hall, l. c. p. 623, Pl. 16, fig. 3, 8. Troost, Monogr. and Proceedings. *Subcarboniferous.* Keokuk limestone.

C. TUMIDUS, Hall, Iowa, Vol. 1, p. 624, Pl. 18, fig. 1, b, c. *Subcarboniferous.* Keokuk limestone.

CYCLOCYSTOIDES, Billings and Salter, 1858. *Silurian.* From the lower and middle Silurian rocks of Canada.

C. DAVISI (Salter), Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 89. *Silurian.*

C. HALLI, Billings and Salter, Geol. Survey of Canada, Palæont., Dec. III. p. 86. *Silurian.* Trenton limestone.

DENDROCRINUS, Hall, 1852.

D. LONGIDACTYLUS, Hall, Palæont. New York, Vol. 2, p. 193, Pl. 43, fig. 1, a–k; Pl. 42, fig. 7, a, b. *Silurian.* Niagara group.

DICHOCRINUS, Münster, 1839.

D. CORNIGERUS, Shumard, Trans. Acad. St. Louis, Vol. 1, No. 1, p. 72, Pl. 1, fig. 1, a–d. *Subcarboniferous.* Buzzard Roost, Alabama.

D. OVATUS, Owen and Shumard, Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 590, Pl. 5 A, fig. 9, a, b. *Subcarboniferous.* Burlington, Iowa.

D. PROTUBERANS, Hall, Iowa, Vol. 1, p. 689, Pl. 25, fig. 7. *Subcarboniferous.* Kaskaskia limestone.

D. SEXLOBATUS, Shumard, Trans. Acad. St. Louis, 1857, Vol. 1, No. 1, p. 73, Pl. 1, fig. 3, a–c. *Subcarboniferous.* Archimedes limestone.

D. SIMPLEX, Shumard, l. c. p. 74, Pl. 1, fig. 2, a, b. Hall, Iowa, Vol. 1, p. 654, Pl. 22, fig. 12, a, b. *Subcarboniferous.* Archimedes limestone, Warsaw limestone.

D. STRIATUS, Owen and Shumard, Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 590, Pl. 5 A, fig. 10, a, b. *Subcarboniferous.* Burlington, Iowa.

DOLATOCRINUS, Lyon, 1857.

D. LACUS, Lyon, Geol. Survey of Ken., Vol. 3, p. 482, Pl. 4, fig. 2, a – c. *Devonian.* Beargrass Creek; Falls of the Ohio.

DORYCRINUS. *Vide* Actinocrinus.

ECHINOENCRINITES, H. von Meyer, 1826.

E. ANATIFORMIS, Hall, Palæont. New York, Vol. 1, p. 89, Pl. 29, fig. 4, a – f. *Silurian.* Trenton limestone.

ECHINOSPHERITES, Wahlenberg, 1821.

E. ———? Hall, in Foster and Whitney's Rep. Superior, Part II. p. 208, Pl. 25, fig. 3, a, b. *Silurian.*

EDRIOASTER, Billings, 1858. CYCLASTER, Geol. Survey of Canada, Rep. 1856, p. 292.

E. BIGSBYI, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 82. *Cyclaster Bigsbyi,* Survey Rep. 1856, p. 293. *Silurian.* Trenton limestone.

ELÆCRINUS. *Vide* Nucleocrinus.

ELEUTHEROCRINUS, Yandell and Shumard, 1856.

E. CASSEDAYI, Yandell and Shumard, Proceed. Acad. Nat. Sci. Phil., Vol. 8, p. 74, Pl. 2, fig. 1 – 5. *Devonian.* Beargrass Creek, near Louisville, Kentucky.

EUCALYPTOCRINUS, Goldfuss (Agas.), 1834.

E. CÆLATUS, Hall, Palæont. N. York, Vol. 2, p. 210, Pl. 47, fig. 4, a – e. *Hypanthocrinites cælatus,* Hall, Geol. Rep. 4th District, 1843, p. 113, fig. 1. *Silurian.* Niagara group.

E. DECORUS, Hall, Palæont. N. York, Vol. 2, p. 207, Pl. 47, fig. 1, 2 a – h, 3 a – d. *Hypanthocrinites decorus,* Phillips, Murchison, Sil. Syst., 1839, p. 672, Pl. 17, fig. 3. *H. decorus,* Hall, 1843, Geol. Rep. 4th Dist. N. York, p. 113, fig. 2, 3. Compare *H. cælatus* ut supra. *Silurian.* Niagara group.

E. PAPULOSUS, Hall, Palæont. N. York, Vol. 2, p. 211, Pl. 47, fig. 5, a, b. *Silurian.* Niagara group.

FORBESIOCRINUS, De Koninck and Lehon, 1854.

F. Agassizi, Hall, Iowa, Vol. 1, p. 630. *Subcarboniferous.*

F. Giddingsii, Hall, Iowa, Vol. 1, p. 633, Pl. 17, fig. 2 – 4. *Subcarboniferous.* Keokuk limestone (?).

F. Meeki, Hall, Iowa, Vol. 1, p. 631, Pl. 17, fig. 3. *Subcarboniferous.* Keokuk limestone.

F. Shumardianus, Hall, Iowa, Vol. 1, p. 671, Pl. 17, fig. 1. *Subcarboniferous.* St. Louis limestone.

F. Whitfieldi, Hall, Iowa, Vol. 1, p. 632. *Subcarboniferous.* Keokuk limestone.

F. Wortheni, Hall, Iowa, Vol. 1, p. 632, Pl. 17, fig. 5. *Subcarboniferous.* Keokuk limestone.

GLYPTOCRINUS, Hall, 1852.

G. decodactylus, Hall, Palæont. N. York, Vol. 1, p. 281, Pl. 77, fig. 1; Pl. 78, fig. 1. *Silurian.* Hudson River group.

G. fimbriatus, Shumard, Geol. Surv. Missouri, Pt. 2, 1855, p. 194, Pl. A, fig. 8, a – c. *Silurian.* Cape Girardeau limestone.

G. plumosus, Hall, Palæont. N. York, Vol. 2, p. 180, Pl. A, 41, fig. 3, a – g. *Actinocrinus plumosus. Silurian.* This species is made out entirely from the fingers and tentacula.

G. ——? Hall, Palæont. N. York, Vol. 2, p. 181, Pl. A, 41, fig. 4. *Silurian.* Clinton group.

GLYPTOCYSTITES, Billings, 1854, Canadian Journ., Vol. 2, p. 215.

G. multiporus, Geol. Survey of Canada, Palæont., Dec. III. p. 54, Pl. 3; Canad. Journ., Vol. 2, p. 215; Rep. 1856, p. 281. *Silurian.* Lower Silurian.

G. Logani, Geol. Surv. Canada, Palæont., Dec. III. p. 59, Pl. 4, fig. 1, a – h. Rep. 1856, p. 282. *Silurian.* Trenton limestone.

G. Logani var. gracilis, l. c. p. 59, Pl. 4, fig. 2. *Silurian.* Trenton limestone.

G. Forbesi, Geol. Survey of Canada, Palæont., Dec. III. p. 59, Pl. 4, fig. 3. *Silurian.* Chazy limestone.

GLYPTORASTER, Hall, 1852.

G. brachiatus, Hall, Palæont. N. York, Vol. 2, p. 187, Pl. 41, fig. 3, a, b. *Silurian.* Niagara group.

GONIASTER, Agassiz, 1834.

G. sp. indet., Graham, Anthony, and James, Sill. Journ., 2d Series, Vol. 1, p. 441. *Silurian.* Cincinnati, Ohio.

GRAPHIOCRINUS, De Koninck and Lehon, 1854.

G. 14-BRACHIALIS, Lyon, Geol. Survey of Kentucky, Vol. III, p. 477, Pl. 1, fig. 1, 2 a, b. *Subcarboniferous.* Near base of Millstone Grit, Crittenden Co., Kentucky.

HEMICYSTITES, Hall, 1852.

H. PARASITICA, Hall, Palæont. N. York, Vol. 2, p. 246, Pl. 51, fig. 18, 19, 20, 20′. *Silurian.* Niagara group.

HETEROCYSTITES, Hall, 1852.

H. ARMATUS, Hall, Palæont. N. York, Vol. 2, p. 229, Pl. 49, A, fig. 3, a – c. *Silurian.* Niagara group.

HETEROCRINUS, Hall, 1847.

H. (?) GRACILIS, Hall, Palæont. N. York, Vol. 1, p. 280, Pl. 76, fig. 3, a, b. *Silurian.* Hudson River group.

H. HETERODACTYLUS, Hall, Palæont. N. York, Vol. 1, p. 279, Pl. 76, fig. 1, a – o. *Silurian.* Hudson River group.

H. SIMPLEX, Hall, Palæont. N. York, Vol. 1, p. 280, Pl. 76, fig. 2, a – d. *Silurian.* Hudson River group.

HOMOCRINUS, Hall, 1852.

H. CYLINDRICUS, Hall, Palæont. N. York, Vol. 2, p. 186, Pl. 41, fig. 2, a – c, 3, a – c. *Silurian.* Niagara group.

H. PARVUS, Hall, Palæont. New York, Vol. 2, p. 185, Pl. 41, fig. 1, a – f. *Silurian.* Niagara group.

H. POLYDACTYLUS, Shumard, Trans. Acad. St. Louis, Vol. 1, No. 1, p. 78, Pl. 1, fig. 6, a, b. *Cyathocrinites*, Chrysty's Letters, Pl. 1, fig. 7, Pl. 3, fig. 1. *Silurian.* Hudson River group, Richmond, Indiana.

ICHTHYOCRINUS, Conrad, Journ. Acad. Nat. Sci. Philad., Vol. 8, p. 279.

I. BURLINGTONENSIS, Hall, Iowa, Vol. 2, p. 557, with diagram. *Subcarboniferous.* Burlington limestone.

I. (?) CLINTONENSIS, Hall, Palæont. New York, Vol. 2, p. 181, Pl. A, 41, fig. 5. *Silurian.* This species is predicated upon fragments of the arms alone.

I. LÆVIS, Conrad, Journ. Acad. Nat. Sci. Philad., Vol. 8, p. 279, Pl. 15, fig. 16. *I. lævis*, Hall, Palæont. N. York, Vol. 2, p. 196, Pl. 43, fig. 2, a – h. *Silurian.* Niagara group.

I. TIARÆFORMIS, Hall, Iowa, Vol. 1, p. 558, with diagram. *Subcarboniferous.* White's Creek, Tennessee.

LECANOCRINUS, Hall, 1852.

L. CALICULUS, Hall, Palæont. N. York, Vol. 2, p. 203, Pl. 46, fig. 3, a, b. *Silurian.* Niagara group.

L. MACROPETALUS, Hall, Palæont. N. York, Vol. 2, p. 199, Pl. 45, fig. 1, a – h. *Silurian.* Niagara group.

L. ORNATUS, Hall, Palæont. N. York, Vol. 2, p. 201, Pl. 44, fig. 2, a – m. *Silurian.* Niagara group.

L. SIMPLEX, Hall, Palæont. N. York, Vol. 2, p. 202, Pl. 46, fig. 2, a – e. *Silurian.* Niagara group.

LEPOCRINITES, Mather, 1830.

L. GEBHARDI, Mather, Geol. N. York, p. 347. *Silurian.* Pentamerus limestone.

LYRIOCRINUS, Hall, 1852.

L. DACTYLUS, Hall, Palæont. N. York, Vol. 2, p. 197, Pl. 44, fig. 1, a – g. *Marsupiocrinites dactylus*, Hall, Geol. Rep. 4th Dist., p. 114, fig. 4, p. 113, 1843. *Silurian.* Niagara group.

MACROSTYLOCRINUS, Hall, 1852.

M. ORNATUS, Hall, Palæont. N. York, Vol. 2, p. 204, Pl. 46, fig. 4, a – g. *Silurian.* Niagara group.

MALOCYSTITES, Billings, 1858.

M. BAWANDI, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 66, Pl. 7, fig. 1, a – i. *Silurian.* Chazy limestone.

M. MURCHISONI, Billings, l. c. p. 67, Pl. 7, fig. 2, a – c. *Silurian.* Chazy limestone.

MARSUPIOCRINITES. *Vide* Lyriocrinus.

MEGISTOCRINUS, Owen and Shumard, 1852. Hall, Iowa, Vol. 2, p. 479, makes it a subgenus of Actinocrinus. We doubt if it is a subcarboniferous fossil.

M. EVANSI, Owen and Shumard, Journ. Acad. Nat. Sci. Philad., Vol. 2, Part 1, p. 68 ; Geol. Survey of Wisconsin, Iowa, and Minnesota, 1852, p. 594, Pl. 5 A, fig. 3, a, b. *Subcarboniferous* (?).

M. LATUS, Hall, Iowa, Vol. 1, p. 480, Pl. 1, fig. 1, a, b. *Devonian.* Hamilton group.

MELOCRINITES, Goldfuss (Agas.), 1834.

M. SCULPTUS, Hall, Palæont. N. York, Vol. 2, p. 228, Pl. 49 A, fig. 2, a – d. *Silurian.* Niagara group.

MELONITES, Owen and Norwood, 1846.

M. MULTIPORA, Owen and Norwood, Sill. Journ., 2d Series, Vol. 11, p. 225, with figure. Remarks on same, Engelmann in Vol. 3, p. 124. *Subcarboniferous.* St. Louis Limestone. This fossil has since been restored to *Palæchinus multipora.*

MYELODACTYLUS, Hall, 1852.

M. BRACHIATUS, Hall, Palæont. N. York, Vol. 2, p. 232, Pl. 45, fig. 7, a – e. *Silurian.* Fragments of arms.

M. CONVOLUTUS, Hall, Palæont. N. York, Vol. 2, p. 192, Pl. 42, fig. 5 a, b, 6 a – h. *Silurian.* Niagara group.

NUCLEOCRINUS, Conrad, 1842. OLIVANITES, Troost's List in Proceed. Amer. Assoc. 1849. ELÆACRINUS, Roemer, 1852.

N. ELEGANS, Conrad, Journ. Acad. Nat. Sci. Philad., Vol. 8, Part 2, p. 235. *Devonian.* Hamilton group.

N. HALLI, Conrad, Geol. 3d Dist. New York, p. 163. *Devonian.* Hamilton group.

N. VERNEUILI, Troost, List and Proceedings. *Pentremites Verneuili*, 6th Rep. Tennessee, 1841. Beadle (D'Orb.), Prodrom. 1, p. 102. *Elæacrinus Verneuili*, Rœmer, Monograph, Blastoid. 1852, p. 59, Pl. 5, fig. 1, a – e. *Olivanites Verneuili*, Lyon, Geol. Survey of Kentucky, Vol. 3, p. 490. *Devonian.* Falls of the Ohio ; Beargrass Creek.

N. ANGULARIS, Lyon, Geol. Survey of Kentucky, Vol. 3, p. 492, Pl. 5, fig. 2, a, b. *Devonian.* Beargrass Creek.

PALÆASTER, Hall, 1852.

P. NIAGARENSIS, Hall, Palæont. N. York, Vol. 2, p. 247, Pl. 51, fig. 21, 22, 23. *Silurian.* Niagara group.

PALÆOCIDARIS. *Vide* Archeocidaris.

PALÆOCYSTITES, Billings, 1858, Geol. Survey of Canada, Palæont., Dec. III. p. 68.

P. CHAPMANI, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 71. *Silurian.* Lower Silurian rocks of the age of the Trenton and Chazy limestones and Hudson River group.

P. DAWSONI, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 70. *Silurian.* Chazy limestone.

P. TENUIRADIATUS, Billings, Geol. Survey of Canada, l. c. p. 69. *Actinocrinus tenuiradiatus*, Hall, Palæont. N. York, Vol. 1, p. 18, Pl. 4, fig. 8, 9. *Silurian.* Chazy limestone.

PALASTERINA, McCoy, 1851, British Foss., p. 59.

P. STELLATA, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 76, Pl. 9, fig. 1, a, 15. Geol. Rep. 1856, p. 290. *Silurian.* Trenton limestone.

P. RUGOSA, Billings, l. c. p. 77, Pl. 9, fig. 2, a – e. Geol. Rep. 1856, p. 291. *Silurian.* Hudson River group.

PENTREMITES, Say, 1820. PENTATREMITITES, Bronn, Index, and European authors generally.

P. BIPYRAMIDALIS, Hall, Iowa, Vol. 1, p. 607, Pl. 15, fig. 2. *Subcarboniferous.* Keokuk limestone.

P. CERVINUS, Hall, Iowa, Vol. 1, p. 690, Pl. 25, fig. 11, a, b. *Subcarboniferous.* Kaskaskia limestone.

P. CHEROKEUS, Hall, Iowa, Vol. 1, p. 691, Pl. 25, fig. 12, a, b; *P. Cherokeus*, Troost, MSS. and Cat. *P. sulcatus*, Rœmer, Monograph. *Subcarboniferous.* Kaskaskia limestone.

P. CONOIDEUS, Hall, Trans. Albany Inst., Vol. 4; Hall, Iowa, Vol. 1, p. 655, Pl. 22, fig. 8, 9, 10. *Subcarboniferous.* Warsaw limestone.

P. CURTUS, Shumard, 1855, Geol. Survey of Missouri, Part 2, p. 187, Pl. B, fig. 3, a, b. *Subcarboniferous.* Archimedes limestone.

P. DECUSSATUS, Shumard, Trans. Acad. St. Louis, 1858, Vol. 1, No. 2, p. 242, Pl. 9, fig. 6, a, b. *Subcarboniferous.* Button-Mould Knob.

P. ELONGATUS, Shumard, 1855, Geol. Survey of Missouri, 2d Rep. Part 2, p. 187, Pl. B, fig. 4. *Subcarboniferous.* Encrinital limestone.

P. FLOREALIS, Say, Journ. Acad. Nat. Sci. Philad., Vol. 4, No. 9; Sowerby, Zoöl. Journ., Vol. 2, p. 311, Pl. 2, fig. 2. *Subcarboniferous.* See P. Godoni.

P. GLOBOSUS, Troost, MSS.; Hall, Iowa, Vol. 1, p. 695, Pl. 25, fig. 17. *Subcarboniferous.* Kaskaskia limestone.

P. GODONI. *Kentucky Asterial fossil*, Parkinson, 1808, Org. Rem., Vol. 2, p. 235, Pl. 13, fig. 36, 37. *Encrina Godoni*, De France, 1818, Dict. Sci. Nat., Tom. 14. *Encrinites florealis*, Schlotheim, 1820, Pet. Got. *Pentremites florealis*, Say, 1822, Sow. Zoöl. Journ., Vol. 2, p. 311, Pl. 11, fig. 2; Troost, Tr. Geol. Soc. Pennsylvania, Vol. 1, p. 224, Pl. 10, fig. 8.

Pentatremitites florealis, Rœmer, 1852, Monogr. Blast., p. 33, Taf. 1, fig. 1 – 4; Taf. 2, fig. 8. *P. Godoni*, Hall, Iowa, Vol. 1, p. 692, Pl. 25, fig. 13, a, b. *Subcarboniferous.* Kaskaskia limestone; Chester, Illinois; Mt. Sano, Alabama, &c.

P. Grosvenori, Shumard, Trans. Acad. St. Louis, Vol. 2, No. 2, 1858, p. 240, Pl. 9, fig. 2, a – d. *Subcarboniferous.* Archimedes limestone.

P. granulatus, Rœmer, 1852, Monogr. Blast., p. 43, Taf. 3, fig. 13. *Granatocrinus cidariformis*, Troost, 1849, List and Proceed., p. 62. *Subcarboniferous.* Allen Co., Kentucky.

P. (Codaster?) Kentuckiensis, Shumard, Trans. Acad. Sci. St. Louis, Vol. 2, No. 2, p. 239, Pl. 9, fig. 5. *Subcarboniferous.* Encrinital limestone.

P. Koninckiana, Hall, Trans. Albany Inst., Vol. 4, 1856; Hall, Iowa, Vol. 1, p. 656, Pl. 22, fig. 11, a – c. *Subcarboniferous.* Archimedes limestone.

P. lanterniformis, Owen and Shumard, 1850, Jour. Acad. Nat. Sci. Philad., Vol. 2, p. 66, Pl. 7, fig. 15. *P. obliquatus*, Rœmer, 1852, Monogr. Blast., p. 47, Taf. 3, fig. 11, a, b; Owen and Shumard, Geol. Survey of Iowa, Wisconsin, and Minnesota, p. 592, Pl. 5 A, fig. 15. *Subcarboniferous.* Archimedes limestone.

P. lineatus, Shumard, Trans. Acad. Nat. Sci. St. Louis, Vol. 2, No. 2, p. 241, Pl. 9, fig. 3, a, b. *Subcarboniferous.* Encrinital limestone.

P. Melo, Owen and Shumard, 1850, Journ. Acad. Nat. Sci. Philad., New Series, Vol. 2, p. 65, Pl. 7, fig. 14, a – c. *Subcarboniferous.* Encrinital limestone.

P. Norwoodi, Owen and Shumard, l. c. p. 64, Pl. 7, fig. 13, a – c. *Subcarboniferous.* Encrinital limestone.

P. ovalis, Say, Sill. Journ. 1st Series, Vol. 2, p. 36 (non Rœmer). *Silurian.* Lockport, New York.

P. obesus, Lyon, 1857, Geol. Survey of Kentucky, Vol. 3, p. 469, Pl. 2, fig. 1, a – d; Hall, Iowa, Vol. 1, p. 695, Pl. 25, fig. 15. *Subcarboniferous.* Iowa, Illinois, and Kentucky.

P. pyriformis, Say, 1822, Journ. Acad. Nat. Sci. Philad., Vol. 4, p. 294; Troost, Trans. Geol. Soc. Penn., Vol. 1, p. 288, Pl. 10; Sowerby, Zoöl. Journ., Vol. 2, p. 315; Rœmer, Monogr.

Blast., p. 84, Taf. 2, fig. 9, a – c; Hall, Iowa, Vol. 1, p. 693, Pl. 25, fig. 16. *Pentremites, n. sp.*, D. D. Owen, Sill. Journ., Vol. 43, 1824, p. 20, fig. 3. *Subcarboniferous.* Kaskaskia limestone, Iowa.

P. Rœmeri, Shumard, 1855, 2d Rep. Geol. Missouri, Part 2, p. 186, Pl. B, fig. 2, a – d. *Devonian.* Chemung group.

P. Reinwardtii, Troost, Trans. Geol. Soc. Penn., Vol. 1, p. 224, Pl. X. *Pentatremitites Reinwardtii*, Rœmer, 1852, Monogr. Blast., p. 52, Pl. 3, fig. 18, a – c. F. Rœmer, Leonhard and Bronn, Jahrb., 1848, p. 296. *Silurian.* Lower Helderberg group.

P. Sayi, Shumard, 1855, 2d Rep. Geol. Survey of Missouri, Part 2, p. 185, Pl. B, fig. 1, a – d. *Subcarboniferous.* Encrinital limestone.

P. stelliformis, Owen and Shumard, 1850, Journ. Acad. Nat. Sci. Philad., New Series, Vol. 2, p. 67, Pl. 7, fig. 16, a, b; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 593, Pl. 5 A, fig. 16, a, b. *Subcarboniferous.* Encrinital limestone.

P. subtruncatus, Hall, Iowa, Vol. 1, p. 485, Pl. 1, fig. 3. *Devonian.* Hamilton group.

P. sulcatus, Rœmer, 1852. *Pentatremitites sulcatus*, Monogr. Blast., p. 34, Taf. 3, fig. 10, a – c. *Subcarboniferous.* Archimedes limestone.

P. symmetricus, Hall, Iowa, Vol. 1, p. 694, Pl. 25, fig. 14. *Subcarboniferous.* Kaskaskia limestone.

P. truncata, Conrad, Proceed. Acad. Nat. Sci. Philad., Vol. 1, p. 334. *Subcarboniferous.*

P. Verneuili. See *Ducleocrinus Verneuili.*

P. Wortheni, Hall, Iowa, Vol. 1, p. 606, Pl. 15, fig. 1. *Subcarboniferous.* Keokuk limestone.

PETRASTER, Billings, 1858, Geol. Survey of Canada, Palæont., Dec. III. p. 79. *Silurian.* Trenton limestone.

P. rigidus, Billings, l. c. p. 80, Pl. 10, fig. 3. *Palasterina rigidus*, Geol. Rep. 1856, p. 291. *Silurian.* Trenton limestone.

PLATYCRINUS, Miller, 1821.

P. Americanus, Owen and Shumard, Journ. Acad. Nat. Sci. Philad., 2d Series, 1851, p. 89, Pl. 11, fig. 1, a, b; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 594, Pl. 5 B, fig. 1, a, b. *Subcarboniferous.* Burlington limestone.

P. Burlingtonensis, Owen and Shumard, l. c. Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 589, Pl. 5 A, fig. 5. *Subcarboniferous.* Burlington limestone.

P. caniculatus, Hall, Iowa, Vol. 1, p. 539. *Subcarboniferous.* Burlington limestone.

P. cavus, Hall, Iowa, Vol. 1, p. 527, Pl. 8, fig. 1, a, b. Compare *P. corrugatus,* Owen and Shumard, Geol. Survey of Iowa, Wisconsin, and Minnesota, p. 589, Pl. 5 A, fig. 2, a – d. *Subcarboniferous.* Burlington limestone.

P. corrugatus, Owen and Shumard, l. c. See *P. cavus.* *Subcarboniferous.* Burlington limestone.

P. discoideus, Owen and Shumard, Journ. Acad. Nat. Sci. Philad., New Series, Vol. 2; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 581, Pl. 5 A, fig. 1; Hall, Iowa, Vol. 1, p. 535, Pl. 8, fig. 8, a, b. *Subcarboniferous.* Burlington limestone.

P. exsertus, Hall, Iowa, Vol. 1, p. 539. *Subcarboniferous.* Burlington limestone.

P. nodobrachiatus, Hall, l. c. p. 542, diagram. *Subcarboniferous.* This may be the young of some known species.

P. nodulosus, Hall, l. c. p. 541. *Subcarboniferous.* Burlington limestone.

P. nucleiformis, Hall, Iowa, Vol. 1, p. 540, diagram. *Subcarboniferous.* Burlington limestone.

P. pileiformis, Hall, Iowa, Vol. 1, p. 529, Pl. 8, fig. 3, a, b. *Subcarboniferous.* Burlington limestone.

P. planus, Owen and Shumard, Journ. Acad. Nat. Sci. Philad., New Series, Vol. 2, 1851; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 587, Pl. 5 A, fig. 4; Hall, Iowa, Vol. 1, p. 533, Pl. 8, fig. 6, a, b. *Subcarboniferous.* Burlington limestone.

P. pœcilliformis, Hall, Iowa, Vol. 1, p. 528, Pl. 8, fig. 2, a, b. *Subcarboniferous.* Burlington limestone.

P. Saffordi, Troost, MSS.; Hall, Iowa, Vol. 1, p. 634, Pl. 18, fig. 5, 6. *Subcarboniferous.* Keokuk limestone.

P. Saræ, Hall, Iowa, Vol. 1, p. 673, Pl. 17, fig. 4. *Subcarboniferous.* Keokuk limestone.

P. sculptus, Hall, Iowa, Vol. 1, p. 536, Pl. 8, fig. 2. *Subcarboniferous.* Burlington limestone.

P. SHUMARDIANUS, Hall, Iowa, Vol. 1, p. 532, Pl. 8, fig. 5. *Subcarboniferous.* Burlington limestone.

P. SUBSPINOSUS, Hall, Iowa, Vol. 1, p. 536, Pl. 8, fig. 9, 10. *Subcarboniferous.* Burlington limestone.

P. TUBEROSUS, Hall, Iowa, Vol. 1, p. 534, Pl. 8, fig. 7, a, b. *Subcarboniferous.* Burlington limestone.

P. TRUNCATULUS, Hall, Iowa, Vol. 1, p. 538, Diagram. *Subcarboniferous.* Burlington limestone.

P. TRUNCATUS, Hall, Iowa, Vol. 1, p. 537, Diagram. *Subcarboniferous.* Burlington limestone.

P. WORTHENI, Hall, Iowa, Vol. 1, p. 530, Pl. 8, fig. 4. *Subcarboniferous.* Burlington limestone.

P. YANDELLI, Owen and Shumard, Journ. Acad. Nat. Sci. Philad.; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 587, Pl. 5 A, fig. 6, a, b. *Subcarboniferous.* Burlington, Iowa.

PLEUROCYSTITES, Billings, 1854, Canad. Journ., Vol. 2, p. 250; Survey Rep. 1857, p. 284. *Silurian.* Lower Silurian.

P. ANTICOSTIENSIS, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 52, Pl. 1, fig. 3. *Silurian.* Hudson River group.

P. ELEGANS, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 51, Pl. 2, fig. 2, a–d. *Silurian.* Trenton limestone.

P. EXORNATUS, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 52. *Silurian.* Trenton limestone.

P. FILITEXTUS, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 50, Pl. 2, fig. 1, a, b. *Silurian.* Trenton limestone.

P. ROBUSTUS, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 49, Pl. 1, fig. 2, a. *Silurian.* Trenton limestone.

P. SQUAMOSUS, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 49, Pl. 1, fig. 1, a–d. *Silurian.* Trenton limestone.

POTERIOCRINUS, Miller, 1821.

P. ALTERNATUS, Hall, Palæont. N. York, Vol. 1, 1847, p. 83, Pl. 28, fig. 1, a–f. *Silurian.* Trenton limestone.

P. CALYCULUS, Hall, Iowa, Vol. 1, p. 553, Pl. 9, fig. 6, a, c. *Subcarboniferous.* Burlington limestone.

P. GRACILIS, Hall, Palæont. N. York, Vol. 1, 1847, p. 84, Pl. 28, fig. 2, a–f. *Silurian.* Trenton limestone.

P. HEMISPHÆRICUS, Shumard, Trans. Acad. Sci. St. Louis, Vol. 1, No. 2, 1858, p. 221. Coal measures.

P. LONGIDACTYLUS, Shumard (non Austin, Crin., Pl. 11. Vide *P. Missouriensis*. *Subcarboniferous.* St. Louis limestone.

P. MEEKIANUS, Shumard, Geological Survey of Missouri, Part 2, p. 188, Pl. A, fig. 7, a, b. *Subcarboniferous.* Encrinital limestone (?).

P. MISSOURIENSIS, Shumard, Trans. Acad. St. Louis, 1857, Vol. 1, No. 1, p. 80. *P. longidactylus*, Geol. Survey of Missouri, p. 188, Pl. B, fig. 5, a – c. *Subcarboniferous.* Shumard proposes *P. Missouriensis* instead of *P. longidactylus* (Austin), which he had unwittingly appropriated.

P. OCCIDENTALIS, Owen and Shumard, Journ. Acad. Nat. Sci. Philad., Vol. 2, 2d Series, 1851 ; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 596, Pl. 5 B, fig. 5, a, b. *Subcarboniferous.* Kaskaskia limestone.

P. RHOMBIFERUS, Owen and Shumard, Journ. Acad. Nat. Sci. Philad., 1851 ; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 595, Pl. 5 B, fig. 2, a – c. *Subcarboniferous.* Burlington limestone.

P. RUGOSUS, Shumard, Trans. Acad. Sci. St. Louis, Vol. 1, No. 2, p. 223. *Subcarboniferous.* Coal measures.

P. SPINOSUS, Owen and Shumard, Journ. Acad. Nat. Sci. Philad., 2d Series, Vol. 2, 1851 ; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 596, Pl. 5 B, fig. 4. *Subcarboniferous.* Chester, Illinois, in Kaskaskia limestone ; Greyson Co., Kentucky.

P. TUMIDUS, Owen and Shumard, Journ. Acad. Nat. Sci., 2d Series, Vol. 2, 1851 ; Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 595, Pl. 5 B, fig. 3, a, b. *Subcarboniferous.* Kaskaskia limestone.

PTEROTOCRINUS, Lyon and Casseday, 1859.*

P. CAPITALIS. *Asterocrinus capitalis*, Lyon, Geological Survey of

* The name *Asterocrinus* was given to a new genus of fossil crinoids described by Lyon. As this name had already been appropriated by Münster, we deem it necessary to change the generic appellation to *Pterotocrinus*. We have, in manuscript, descriptions of several new species of this peculiar genus of Crinoidea.

Kentucky, Vol. 3, p. 472, Pl. 3, fig. 1, a – k. *Subcarboniferous.*

P. CORONARIUS. *A. coronarius*, Lyon, l. c. p. 476, Pl. 1, fig. 1, 1 a. *Subcarboniferous.*

PYGORYNCHUS, Agassiz, 1839.

P. GOULDI, Bouvé, Proc. Bost. Soc. Nat. Hist., Dec., 1846, p. 192. Its position (Millstone Grit) as given by M. Bouvé is, we think, exceedingly doubtful.

RHODOCRINUS, Miller, 1821.

R. WORTHENI, Hall, Iowa, Vol. 1, p. 556, Pl. 9, fig. 8, a – c. *Subcarboniferous.* Burlington limestone.

SACCOCRINUS, Hall, 1852.

S. SPECIOSUS, Hall, Palæont. N. York, Vol. 2, p. 205, Pl. 46, fig. 1, a – n, fig. 2. *Silurian.* Niagara group.

SCAPHIOCRINUS, Hall, 1858, Iowa, Vol. 1, p. 549.

S. DACTYLIFORMIS, Hall, Iowa, Vol. 1. p. 670, Pl. 17, fig. 6. *Subcarboniferous.* St. Louis limestone.

S. DECABRACHIATUS, Hall, Iowa, Vol. 1, p. 679, Pl. 25, fig. 1. *Subcarboniferous.* Kaskaskia limestone.

S. DICHOTOMUS, Hall, Iowa, Vol. 1, p. 553, diagram. *Subcarboniferous.* Burlington limestone.

S. INTERNODIUS, Hall, Iowa, Vol. 1, p. 679, Pl. 25, fig. 2. *Subcarboniferous.* Kaskaskia limestone.

S. SCOPARIUS, Hall, Iowa, Vol. 1, p. 680, Pl. 25, fig. 3, a, b. *Subcarboniferous.* Kaskaskia limestone.

S. SIMPLEX, Hall, Iowa, Vol. 1, p. 551, Pl. 9, fig. 10. *Subcarboniferous.* Burlington limestone.

SCHIZOCRINUS, Hall, 1847.

S. NODOSUS, Hall, Palæont. N. York, Vol. 1, p. 81, Pl. 27, fig. 1, a – h; Foster and Whitney, Lake Superior, p. 208, Pl. 25, fig. 2, a – c. *Silurian.* Trenton limestone.

S. STRIATUS, Hall, Palæont. N. York, Vol. 1, p. 316, Pl. 28, fig. 4, a – c. *Silurian.* Trenton limestone.

S. sp. indet., Hall, l. c. p. 86, Pl. 29, fig. 1. *Silurian.* Trenton limestone.

SCHYPHOCRINUS, Hall, 1847.

S. heterocostalis, Hall, Palæont. N. York, Vol. 1, p. 85, Pl. 28, fig. 3, a – f. *Silurian.* Trenton limestone.

STENASTER, Billings, 1858. *Silurian.* Lower Silurian.

S. pulchellus, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 79, Pl. 10, fig. 2. *Silurian.* Trenton limestone.

S. Salteri, Billings, l. c. p. 78. Pl. 10, fig. 1, a, b. *Silurian.* Trenton limestone.

STEPHANOCRINUS, Conrad, 1842.

S. angulatus, Conrad, Journ. Acad. Nat. Sci. Philad., Vol. 8, p. 279, Pl. 15, fig. 18; Hall, Palæont. N. York, Vol. 2, p. 212, Pl. 48, fig. 1, a – m. *Silurian.* Niagara shale, Lockport.

S. gemmæformis, Hall, l. c. fig. 2, a – i. *Silurian.* Niagara group.

SYNBATHOCRINUS, Phillips, 1836.

S. dentatus, Owen and Shumard, Journ. Acad. Nat. Sci. Philad., Vol. 2, 2d Series; Idem, Geol. Survey of Wisconsin, Iowa, and Minnesota, p. 597, Pl. 5 B, fig. 7, a, b. *Subcarboniferous.* Burlington limestone.

S. matutinus, Hall, Iowa, Vol. 1, p. 483, Pl. 1, fig. 2. *Devonian* Hamilton group.

S. Swallovi, Hall, Iowa, Vol. 1, p. 672, Pl. 17, fig. 89. *Subcarboniferous.* St. Louis limestone.

S. Wortheni, Hall, Iowa, Vol. 1, p. 560, Pl. 9, fig. 9. *Subcarboniferous.* Burlington limestone.

SAXOCRINUS, Phillips, 1836.

S. interscapularis, Hall, Iowa, Vol. 1, p. 482, Pl. 1, fig. 3. *Devonian.* Hamilton group.

TÆNICASTER, Billings, 1858.

T. cylindricus, Billings, Geol. Survey of Canada, Palæont., Dec. III. p. 81, Pl. 10, fig. 4, a, b. *Silurian.* Trenton limestone.

T. spinosus, Billings, l. c. Pl. 10, fig. 3, a – d. *Palæocoma spinosa,* Billings, Geol. Survey of Canada, Rep. 1856, p. 292. *Silurian.* Trenton limestone.

THYSANOCRINUS, Hall, 1852.

T. ACULEATUS, Hall, Palæont. N. York, Vol. 2, p. 190, Pl. 42, fig. 3, a–d. *Silurian.* Niagara group.

T. CANALICULATUS, Hall, Palæont. N. York, Vol. 2, p. 189, Pl. 42, fig. 2, a–d. *Silurian.* Niagara group.

T. IMMATURUS, Hall, Palæont. N. York, Vol. 2, p. 191, Pl. 42, fig. 4, a–f. *Silurian.* Niagara group.

T. LILIIFORMIS, Hall, l. c. fig. 1, a–f. *Silurian.* Niagara group.

VASOCRINUS, Lyon, 1857.

V. SCULPTUS, Lyon, Geol. Survey of Kentucky, Vol. 3, p. 486, Pl. 4, fig. 3, b–e. *Devonian.* Beargrass Creek, Kentucky.

V. VALENS, Lyon, l. c. fig. 3, 3 a. *Devonian.* Beargrass Creek, Kentucky.

ZEACRINUS, Troost, MSS. (Hall).*

Z. DEPRESSUS, Troost, MSS.; Hall, Iowa, Vol. 2, p. 546. *Subcarboniferous.*

Z. ELEGANS, Hall, Iowa, Vol. 1, p. 547, Pl. 9, fig. 12. *Subcarboniferous.*

Z. INTERMEDIUS, Hall, Iowa, Vol. 1, p. 681, Pl. 25, fig. 4. *Subcarboniferous.* Kaskaskia limestone.

Z. MAGNOLIÆFORMIS, Troost, MSS.; Hall, l. c. pp. 684, 545, 544. *Subcarboniferous.* Pentremital limestone, Tennessee.

Z. MANIFORMIS, Hall, l. c. p. 682, Pl. 25, fig. 8. *Poteriocrinus maniformis*, Yandell and Shumard, Contrib., p. 24, Pl. 1, fig. 2. *Cyathocrinus maniformis*, Yandell and Shumard, Contributions. *C. gracilis*, Troost, Cat. *Subcarboniferous.* Kaskaskia limestone, Illinois; Archimedes limestone, Kentucky.

Z. RAMOSUS, Hall, Iowa, Vol. 1, p. 548, Pl. 9, fig. 3. *Subcarboniferous.* Burlington limestone.

Z. WORTHENI, Hall, Iowa, Vol. 1, pp. 545, 683, with diagram. *Subcarboniferous.* Kaskaskia limestone.

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* "This genus begins its existence, so far as known, in the Burlington limestone, and continues to the Chester limestone, becoming far more abundant and extravagant in its forms in the latter period." — HALL.

Four hundred and sixty-ninth meeting.

September 13, 1859. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from M. Liouville, of Paris, in acknowledgment of the notice of his election as a Foreign Honorary Member. Also various letters relating to the exchanges of the Academy.

Professor Peirce made a communication upon some of the laws of Astronomical Cosmology.

Professor Horsford gave an account of the so-called sap-sand found in maple sugar, which he had ascertained to be a neutral tartrate of lime.

Dr. B. A. Gould, Jr. laid before the Academy a circular from a committee of the American Association for the Advancement of Science, addressed to the friends of Astronomy, being an appeal in behalf of a new attempt to determine the solar parallax.

Dr. Beck mentioned, that while on his late tour in Europe, being in search of manuscripts of the *Satyricon* of Petronius Arbiter, he found, in the Bibliotheca Ricardiana at Florence, and the Bibliotheca Vaticana at Rome, two small manuscripts of grammatical or bibliographical contents, which he believes have not yet been published. Both manuscripts bear the name Petronius Arbiter, the Vatican manuscript with the addition, "de antiquis dictionibus." The relation of this fragment to A. Gellius, Nonius, and other authors of this class, and the question whether the author has borrowed from them or from common sources, are of some interest. The fragment, although not of great importance, is of sufficient interest to justify its publication. Dr. Beck hopes to be able, from the two manuscripts and other means, to construct, with one or two exceptions, a reliable text, which he intends to append to the result of his inquiries concerning the text and manuscripts of the *Satyricon*, which he is now engaged in preparing.

Professor Gray presented the following paper: —

Notes upon some Rubiaceæ, collected in the South Sea Exploring Expedition under Captain Wilkes. By Asa Gray, M. D. (Continued from April, 1858: *vide* p. 50.)

Coprosma calycina: herbacea, repens, fere glabra; foliis ovato-rotundis ciliolatis breviter petiolatis; stipulis obsoletis; floribus subsolitariis subsessilibus 4–5-meris; calycis lobis ovato-lanceolatis foliaceis ovario obovato æquilongis corolla tubulosa vix dimidio brevioribus. Hedyotis repens, *Clos in Gay, Fl.* 3, *p.* 208. — Chili, common in the province of Valdivia, &c., *C. Gay.* — It is odd that this plant, having been correctly described, except that the dry drupe is called a capsule, should yet have been mistaken for a *Hedyotis*. It really forms a connecting link between *Nertera* (of which it has the habit) and *Coprosma;* but is peculiar for its large calyx-lobes, which persist on the young fruit. According to Clos, it is monœcious or diœcious, which, with the developed lobes of the calyx, would fix the plant in *Coprosma*. But the only flower upon my specimen is hermaphrodite!

7. *Corrections and Additions to the former article.*

Psychotria parvula, p. 13, is only a form of *P. serpens*, Linn., as appears upon a comparison with specimens from Hong Kong, and from the Loo Choo and Bonin Islands.

P. turbinata, p. 12. — Mr. Bentham has distributed No. 2086 of Spruce's Amazon collection under the same name; but as the flowers of that plant seem equally to be unknown, it may be best to retain the name for the Feejean species, which can hardly be any else than a *Psychotria*.

Among some Polynesian *Rubiaceæ*, collected by Mr. Milne in the recent cruises of the Herald, British surveying vessel, and placed in my hands by Dr. Hooker, I notice two species which may be referred to the genus *Calycosia*, p. 15, although their flowers are in loose cymes: —

Calycosia pubiflora (sp. nov.): foliis membranaceis glabris oblongo-lanceolatis acuminatis in petiolum attenuatis (4–6-poll. longis); cyma laxa trichotoma calycisque tubo viscoso-pubescentibus, limbo crateriformi extus puberulo; drupa turbinata, pyrenis chartaceis intus excavatis. — Viti-levu, Feejee Islands, *Mr. Milne.* — Limb of the calyx apparently white, half an inch in diameter. Corolla hardly exserted.

CALYCOSIA MILNEI (sp. nov.) : glaberrima; foliis oblongis sublanceolatisve basi attenuatis longiuscule petiolatis punctulatis (3 – 4-pollic.); cyma diffusa repetito-trichotoma; pedicellis gracilibus. — "Anuteum [Feejee Islands?], Nov. 1853, a slender shrub, frequent on high grounds," *Mr. Milne.*

8. *Scyphiophora.*

Epithinia of Jack has been identified by Korthals with the little-known *Scyphiophora* of the younger Gærtner. Jack's description appears to be perfectly correct, so far as it goes (except as to the absence of stipules). But — as respects the various subsequent attempts to complete the generic character — it may be noted that the upper ovule is not pendulous from the apex of the cell, as stated by Wight and Arnott; nor are the ovules solitary in each cell, as stated by Hasskarl; nor is the upper ovule prematurely abortive, as Miquel describes it. The two long and narrow cells of the ovary each contain a pair of anatropous ovules, borne on slender funiculi, which are inserted on the dissepiment at the middle of the cell; the upper one is erect, the lower one pendulous. The funiculi are more or less thickened at their apex, so as to cap the base of the ovule, as in the *Guettardeæ* generally. Not rarely all four ovules are fertilized. In the fruit each cell becomes constricted between the seeds into two imperfect *locelli*, one above the other. The seeds are conformed to the cavity, and are somewhat curved. In those examined, which were not perfectly mature, the albumen was almost wanting; the cotyledons oblong, flattish, and longer than the radicle. The putamen does not readily separate into two pyrenæ. The corolla is contorted in æstivation, and sometimes pentamerous. The genus should perhaps be appended to the *Guettardeæ.*

9. *Bikkia.*

Bikkia grandiflora, Reinw., or *B. australis*, DC., or more properly *B. tetrandra* (*Portlandia tetrandra* of Forster), was collected at the Friendly Islands, in fine specimens, by Professor Harvey. The corolla is valvate in æstivation, as in *Portlandia*, but strongly reduplicate, so that the summit of the flower-bud is cruciately four-angled or winged. Stigma bilamellar; the lobes short, oblong, and thickish. Ovules oblong, horizontal. Testa of the immature seeds conformed to the nucleus.

10. *Cinchoneæ.*

The following are two new genera of this subtribe in the collection of the South Sea Exploring Expedition; one of them founded upon Forster's *Cinchona corymbifera*, the other upon new discoveries.

BADUSA, Nov. Gen.

Calyx tubo clavato; limbo brevi cupulato 5-dentato persistente. Corolla hypocraterimorpha, glabra, 5-fida; limbo tubum adæquante, lobis lineari-oblongis æstivatione contorto-imbricatis (uno exteriore), explicatis patenti-recurvis. Stamina 5, exserta: filamenta filiformia, imæ basi corollæ inserta, inferne villosa; antheræ lineares, dorso supra basim affixæ, mox versatiles. Stylus filiformis, ramis 2 brevibus cum stigmatibus subcapitatis intus planis in clavellam angulatam conglutinatis. Ovarium biloculare. Ovula in placentis lineari-oblongis crassis plurima, anatropa, sese imbricantia, superiora adscendentia, inferiora pendula. Capsula clavato-oblonga, cartilaginea, bilocularis, polysperma, ab apice ad basim septicida. Semina ovalia, modice alata. Embryo rectus albumine carnoso paullo brevior; radicula tereti cotyledonibus ovatis longiore. Frutices sempervirentes? Oceanici, glabri; stipulis brevibus vaginatis; pedunculis axillaribus apice foliatis cymoso-pluri-floris; floribus albis.

BADUSA CORYMBIFERA. Cinchona corymbifera, *Forst.* C. Philippica, Cav.? Exostemma, *R. & S.* — Distinguished from *Exostema* by the æstivation, the versatile anthers, and the inflorescence.

DOLICHOLOBIUM, Nov. Gen.

Calyx tubo cylindrico elongato; limbo amplo submembranaceo cyathiformi truncato integerrimo (rariusve sublobato) persistente. Corolla hypocraterimorpha; limbo 4–5-partito, lobis oblongis obtusissimis plurinerviis æstivatione contortis. Stamina 4–5, tubo infra faucem inserta, glabra, inclusa: filamenta brevissima: antheræ lineares, basifixæ, introrsum adnatæ. Stylus bifidus, ramis subspathulatis sursum petaloideo-dilatatis intus secus costam stigmatosis. Ovarium biloculare. Ovula in placentis elongatis crassis numerosissima, minuta, sursum imbricata, acicularia. Capsula siliquæformis, teretia, longissima (4–6-pollicaris), calycis limbo crateriformi seu pateriformi (fructu multoties latiori) plerumque coronata, demum septicida? Semina creberrima, nucleo ovali, ala angusta utrinque in caudam simplicem longissimam sensim attenuata. Embryo in albumine parco carnoso rectus; cotyledonibus ovatis radicula infera parum brevioribus. — Frutices Vitienses; foliis membranaceis petiolatis recte penninerviis, venulis pulchre reticulatis; stipulis interpetiolaribus membranaceo-foliaceis distinctis obtusis planis plerumque caducis; pedunculis brevibus ex axillis superioribus tri-paucifloris; floribus majusculis; tubo calycis et corollæ (albæ?) extus pube appressa indutis. — Genus *Cosmibuenæ* affine.

Dolicholobium oblongifolium (*Gray, l. c.*): foliis oblongis seu elongato-oblongis utrinque acutiusculis ($2\frac{1}{2}$–5 poll. longis); flore pentamero. — Collected at Sandal-wood Bay, Vanua-levu, one of the Feejee Islands, in fruit, in the Pacific Exploring Expedition; afterwards, in blossom, by Mr. Milne, which afforded the materials required for characterizing the genus.

Dolicholobium latifolium (*Gray, l. c.*): foliis latissime obovatis basi rotundatis vel obtusissimis (5–7 poll. longis); flore tetramero, an semper? — Ovolau, Feejee Islands.

Coutarea of Aublet has the æstivation of the corolla *imbricative* (with the tube somewhat plaited), not induplicate, as stated by Endlicher, who thus led Weddell to rank the genus among those with valvular or modified valvular æstivation. Endlicher has omitted to mention that the corolla is curved or unequally ventricose in the bud. In *C. Mexicana* the flowers are, at least sometimes, pentamerous.

11. *Randieæ.*

From the South Sea Islands we have three species of *Stylocoryne*, viz.: —

Stylocoryne sambucina, which must take this name because it is, as I suppose, Forster's *Coffea sambucina*, although one form of it is certainly Bentham's *Stylocoryne pepericarpa.*

Stylocoryne coffæoides, which I take for Forster's *Coffea odorata.* It is the *Stylocoryne racemosa* of Hooker and Arnott in Beechey's voyage (from Tahiti), but not, I suppose, of Cavanilles (from Manilla), in which the calyx is described and figured as pretty strongly 5-toothed, while in this the limb is truncate and barely denticulate.

Stylocoryne Harveyi (*Gray, l. c.*): glaberrima; foliis chartaceis oblongis acuminatis basi in petiolum longiusculum contractis; cymis axillaribus terminalibusque petiolum vix superantibus subsessilibus; calycis limbo quadrifido, lobis triangulari-subulatis tubo vix brevioribus; corollæ lobis 4 lineari-oblongis tubo longioribus, fauce imberbi. Aff. præcedenti. — Feejee Islands, Prof. Harvey.

GOULDIA, Nov. Gen.

Calyx tubo obovato vel turbinato; limbo brevi quadrifido. Corolla hypocraterimorpha, subcoriacea, undique glabra; limbo quadripartito, lobis æstivatione valvatis. Stamina 4, fauci corollæ inserta: filamenta brevissima: antheræ inclusæ, oblongo-lineares, acutæ. Stylus gracilis, apice bifidus: stigmata filiformia, acuta, in una specie crassiora. Ovarium biloculare. Ovula in placentis crassis, medio dissepimento utrinque insertis, plurima, parva, amphitropa. Bacca drupacea bilocularis, endocarpio pergameno; placentis spongioso-carnosis alveolatis oligo–pleiospermis. Semina angulata vel complanata, peltata, nunc in alveolis placentæ subimmersa: testa nucleo conformis, tenui-crustacea, pellicula papuloso-reticulata. Embryo intra albumen subcartilagineum rectus; cotyledonibus ovatis parvis radicula vix brevioribus. — Frutices vel arbusculæ insularum; foliis oblongis brevi-petiolatis; stipulis brevibus utrinque integris subvaginatis; floribus viridulis albidisve cymosis vel subsolitariis.

GOULDIA SANDWICENSIS. Kadua affinis, *Cham. & Schlecht.* Var. TERMINALIS. Petesia? terminalis, *Hook. & Arn.* Var. CORIACEA. Petesia? coriacea, *Hook. & Arn.* Var. HIRTELLA. — A polymorphous species.

GOULDIA ROMANZOFFIENSIS. Kadua Romanzoffiensis, *Cham. & Schlecht.* Petesia carnosa, *Hook. & Arn.*

I have much pleasure in dedicating this genus to Augustus A. Gould, M. D., a distinguished zoölogist, author of the Natural History of the Invertebrata of Massachusetts, and of the Conchology of the South Sea Exploring Expedition under Captain Wilkes. These species were taken for congeners by Chamisso and Schlechtendal, who included them in their genus *Kadua*, and afterwards, quite independently, by Hooker and Arnott, who referred them to the much-vexed or factitious genus *Petesia*. On the whole, they appear to be properly associated, although the differences between them are not unimportant. *G. Sandwicensis* is more related to *Stylocoryne*. *G. Romanzoffiensis*, with its distinctly vaginate, though very short, and conpetiolar stipules, and with the large, pyriform, whitish, drupaceous berry opening at maturity at the naked apex by a round hole or short chink, through which it may discharge the seeds, is really allied to *Kadua*. But besides the truly baccate or drupaceous fruit, with the limb of the calyx obliterated, the few and peltate seeds are quite different. On the other hand, the æstivation of the corolla and the bifid style perfectly distinguish this genus from *Stylocoryne*, as does the former character from *Fernelia*. As to *Petesia*, that genus is known to have been founded upon species of *Rondeletia*, to which the wholly obscure species added by Jacquin is thought to belong; the *P. spicata* of Swartz is probably *Gonzalea spicata;* Gærtner's *P. carnea*, on which De Candolle founded his dubious genus *Eumachia*, is perhaps an *Ixora;* and finally the Philippine and Mexican species proposed by Bartling, and adopted by De Candolle, are still obscure, and perhaps themselves heterogeneous. There is small likelihood that any of them are congeners of the species here characterized.

12. *Rondeletieæ.*

Lerchea calycina (*Gray, l. c.*): foliis oblongo-lanceolatis acuminatis basi attenuatis, junioribus (præsertim costis venisque subtus cum stipulis integerrimis ovato-lanceolatis caudato-acuminatis ramulis floribusque) ferrugineo-sericeis; cymis condensatis; lobis calycis lineari-spathulatis foliaceis tubo corollæ parum brevioribus. — Ovolau, Feejee Islands, in fruit only; Viti-levu, Mr. Milne (in herb. Hook.), with blossoms.

This is evidently a near relative of Reinwardt's *Xanthophytum fruticulosum.* Indeed, should Blume's character, *stipulæ geminata, magnæ, bifidæ*, be incorrect, nothing of consequence would remain in the description to distinguish that plant from the present. But Mr. Bennett's remark (in Pl. Jav. Rar., p. 101) implies that the æstivation of the corolla in the original *Xanthophytum* is imbricative (or rather convolutive), as in *Wendlandia*. In the present plant it is certainly valvular. So that, whether *X. fruticulosum* is to fall into *Lerchea* or not, our present plant must do so, although the enlarged and foliaceous calyx-lobes seem to be peculiar. The stigma is that of *Xanthophytum.* The cocci are at length ventrally dehiscent and similar to those of the subgenus *Diplophragma* of *Hedyotis;* from which the large epigynous disk and the interpetiolar stipules mainly separate it.

The species of *Ophiorhiza* are by no means well characterized. Of the three here proposed, the first is the most peculiar; the second and the third are perhaps confluent.

Ophiorhiza peploides (*Gray, l. c.*): herbacea, pumila, diffuse ramosa; ramis puberulis foliosis; foliis parvis sæpe 3–5-natis vel pseudo-verticillatis spathulatis seu ovato-spathulatis basi longe attenuatis glabris; floribus subsolitariis glabris; filamentis filiformibus styloque exsertis. — Feejee Islands; also collected by Mr. Milne, and a smaller-leaved form by Prof. Harvey. The leaves resemble those of *Peplis Portula.*

Ophiorhiza leptantha (sp. nov.): fruticosa, fere glabra; foliis lætevirentibus oblongo- seu elongato-lanceolatis utrinque acuminatis longe petiolatis; stipulis utrinque binis setaceis; cyma multiflora puberula; floribus plerisque secundis subsessilibus; corolla alba gracili pollicari, ore tenuissime barbato; staminibus inclusis; filamentis anthera æquilongis; stylo glabro. — Feejee Islands: also collected by Prof. Harvey.

Ophiorhiza laxa (sp. nov.): fruticosa; ramis junioribus sæpe ferrugineo-puberulis; foliis oblongis vel subovatis acuminatis longe petiolatis; cymis pauci-plurifloris laxis; floribus pedicellatis; corolla semipollicari; cæt. fere præcedentis, sed ramosior laxior. — Feejee Islands: also gathered by Mr. Milne.

13. *Hedyoteæ.*

Oldenlandia, Houstonia, Hedyotis, etc. It is unnecessary to recapitulate the history of the ancient genera *Oldenlandia* (1703), *Houstonia* (1737), and *Hedyotis* (1747), previous to the consummation of their union by Wight and Arnott into one polymorphous, or, as they justly term it, compound genus, for which, following Lamarck, the latest of the three names was adopted. Korthals has since proposed the establishment, or re-establishment, of all Wight and Arnott's principal sections as distinct genera. Bentham, taking an intermediate view, and depending mainly upon dehiscence, adopts two of the Linnæan genera, viz. *Hedyotis* (to which he refers *Dimetia* as well as *Macrandia* and *Diplophragma*) and *Oldenlandia* (to include *Houstonia, Anotis,* &c.), and also admits *Scleromitrion* and *Kohautia.* I had adopted Bentham's view, without particular investigation. But I now come to the conclusion, that all three Linnæan genera equally merit restoration, or at least that *Houstonia* is more definitely distinguishable from *Oldenlandia* than it is from *Hedyotis,* as the latter is received by Bentham. For the *Dimetiæ* and *Macrandriæ* generally, and many of the *Diplophragmæ,* not only accord with *Anotis* in habit, in flowers, and in the structure of the seed, but also in the dehiscence, which is loculicidal across the vertex of the capsule in the first instance; and although at length the fruit may readily split septicidally, even into two cocci, so it does in various *Houstoniæ* or *Anotides*, as is well seen in *H.* (*A.*) *angustifolia*, of the United States.

Hedyotis, Linn., proper, is well marked by its small, globular, hard and nut-like fruit, either indehiscent or tardily septicidal into closed cocci: and the seeds are peltate but not concave on the face; the corolla is short; the inflorescence axillary and glomerate; the stipules are mostly setose; and the leaves lineate-nervose.

Scleromitrion, equally Spermacoceous in aspect, differs from *Hedyotis* in having the fruit loculicidal across the summit, and the seeds of *Oldenlandia*.

Oldenlandia has a thin loculicidal capsule, with the very numerous and small seeds angular or globular, mostly obpyramidal or trihedral, not obcompressed nor hollowed on the face. *Karamyschewia* of Fischer and Meyer, from the Caucasian region, is an *Oldenlandia*, near *O. umbellata*, with two or more accessory calyx-teeth.

Kohautia, "too well marked in habit and character to be merged into *Hedyotis*," has the capsule and seeds of *Oldenlandia*, from which, irrespective of habit, it is distinguished only by the form of the corolla.

Houstonia, besides the (mostly) elongated corolla, is distinguished from *Oldenlandia* by the peltate seeds, hollowed or concave on their inner face. These are few or moderately numerous, — never very numerous, as in *Oldenlandia*. In *Euhoustonia* the seeds are deeply crateriform or thimble-shaped, and the globular-didymous pod is partly superior.*

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* EUHOUSTONIEÆ Americæ Borealis.

1. Capsula matura vix aut fere semisupera.

* Corollæ tubus calycem (sæpius longe) superans.

+ Semina globuloso-acetabuliformia, pl. m. scrobiculata, cavea hilari profunda sine crista mediana, ore rotundo.

++ Pedunculi plerique axillares, fructiferi nutantes.

H. ROTUNDIFOLIA, *Michx.* Seminum testa profundius scrobiculata.

++ ++ Pedunculi erecti filiformes. Semina subtiliter scrobiculata.

H. SERPYLLIFOLIA, *Michx.*

H. CÆRULEA, *Linn.*

The Indian *H. Rheedii* (*Hedyotis Rheedii*, Wight & Arn.) should probably be referred to *Euhoustonia*, notwithstanding the reduction of the ovules and seeds to a single pair. These closely resemble those of the typical *H. cærulea*. But *Hedyotis Wightiana*, Wall., associated with the former by Wight and Arnott, is truly a *Hedyotis*; the hard nucumentaceous fruit (in good Hookerian specimens) not being loculicidal at the summit, but splitting readily through the narrow partition into two closed, or at length ventrally dehiscent cocci, and the seeds are not meniscoidal, but flat-lenticular, as in genuine *Hedyotis*.

Although I have not seen the seeds, I have little hesitation in proposing to constitute a peculiar subgenus, *Macrohoustonia*, for two shrubby, large-flowered, Mexican species which Kunth referred to *Bouvardia*. This affinity in the case of one of them, *H. triflora*, has been noticed by Bentham; for his *Anotis longiflora*, Pl. Hartw. no. 206, is apparently *Bouvardia triflora*, H. B. K., the figure of which De Candolle has omitted to quote. The other, *H. longiflora*, is *Æginetia longiflora*, Cav., *Bouvardia longiflora*, H. B. K. Coulter's specimens (no. 215, from Real del Monte) want the fruit. But the seeds, as figured and described by Cavanilles, appear to resemble those of *H. rubra*, but with the thin margin more decidedly winged. Whether or not these plants

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+- +- Semina depresso-acetabuliformia, lævia, intra caveam hilo lineari elevato notata, ore ovali: cæt. præcedentium.

H. PATENS, *Ell.* Hedyotis cærulea β. minor et H. minima, *Torr. & Gray, Fl.* 2, p. 38, pro parte.

** Corollæ tubus lobos calycis amplos haud superans: pedunculi præcociores elongati, fructiferi patentes: semina fere *H. cæruleæ* sed majora.

H. MINIMA, *Beck.* Hedyotis minima, *Torr. & Gray*, l. c. pro parte, excl. char. Planta vernalis; caulibus demum ramosis 3-4-pollicaribus patentissimis; foliis scabris, imis ovatis vel spathulatis, superioribus oblongis sublinearibusve; corollæ lobis tubo æquilongis. Calycis lobi sesquilineales.

2. Capsula apice tantum libera: semina fere sect. 3: corolla parva: pedunculi fructiferi laterales patentissimi.

H. SUBVISCOSA. Oldenlandia subviscosa, *C. Wright, in Gray, Pl. Wright.* 2. p. 68, adn. Texas, *Wright, Berlandier*, coll. no. 991, 2421.

3. Capsulæ maturæ $\frac{2}{3}$-$\frac{3}{4}$ superæ, e pedunculis brevissimis lateralibus recurvis pendulæ: semina lævissima, patenti-crateriformia, lateribus tenuibus quasi alatis, intus hilo lineari elevato notata.

H. HUMIFUSA. Hedyotis (Houstonia) humifusa, *Gray, Pl. Lindl.* 2. p. 216, & *Pl. Wright.* 1. p. 82. — Corolla breviuscula.

H. RUBRA, *Cav.* Corollæ tubo elongato-filiformia.

be admitted into *Houstonia*, they will hardly be left as congeners of *Bouvardia triphylla* or *Jacquini*.

Anotis, DC. will constitute the largest subgenus of *Houstonia*, including all of De Candolle's first and second sections, and of Arnott's third division of his subgenus of this name, except perhaps *Hedyotis monosperma;* and also two of De Candolle's three species of his genus *Rachicallis.* For his *R. nitida* and *R. Caracasana* are inseparable from his *Anotis setosa*, &c. The accessory calyx-teeth or interposed setæ are not constant nor of any consequence, (several *Houstoniæ* and *Hedyotideæ* vary in this way,) and the æstivation of the corolla is valvular, as in all true *Hedyoteæ*.* Not so, however, in *R. rupestris*, of the West Indies, the obvious type of *Rachicallis:* in this the lobes of the corolla are strongly imbricated, as in *Rondeletia.* The seeds of *Anotis* are meniscoidal, cymbiform, or at least concave on the inner face, and marked with a longitudinal hilar ridge: in some species they are undistinguishable from those of true *Houstonia.* If in others their margins are not inflexed so as to be distinctly concave on the inner face, they are never like those of *Oldenlandia.*

The nicer question remains as to what is to be done with sundry groups of Indian, Chinese, and Insular species, which stand between *Anotis* and true *Hedyotis.* I have examined a considerable number of them, but must refer the question to some botanist who can command fuller materials. As far as my examination extends, their seeds are all much alike, and are essentially those of *Hedyotis*, being compressed-lenticular and peltate, with a small, more or less protuberant hilum, not at all hollowed on the inner face, but with acute edges. The specimens I possess are reducible to two principal groups of species. First, those in which the summit of the capsule is more or less exserted beyond the calyx, and primarily loculicidal in dehiscence. In the remarkable *Hedyotis leptopetala*, Gray,† the pod and its dehiscence accord very well with those of American *Anotides.* In *H. scandens*, one

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* Wight and Arnott characterized their *Hedyotis* as having the lobes of the corolla "imbricated (not twisted) in æstivation." This obvious error has been copied all along by Endlicher, by Torrey and Gray, and recently by Miquel.

† Botany of Japan, in Mem. Amer. Acad. 6, p. 394. The patent fact has since arrested my attention, that this is the *Leptopetalum Mexicanum* of Hooker and Arnott, in the Botany of Beechey's Voyage, where there is a good figure; so that this belonged to that unfortunate parcel of specimens collected at the Loo Choo and Bonin Islands, but supposed to have come from Mexico.

of the types of *Dimetia*, and in *H. recurva*, Benth. (allied to *H. macrostema*, Hook. & Arn., the type of the section *Macrandria*, which I have not seen), the free summit is very soon septicidal also. These species, which may be taken to represent Wight and Arnott's *Dimetia* and *Macrandria*, accord far better in aspect and character with *Houstonia* (section *Anotis*) than with true *Hedyotis*, and would perhaps form a subgenus of the former, if not to be distinguished from both.

On the other hand, all Wight and Arnott's species of their subgenus *Diplophragma*, having wholly inferior and purely septicidal-dicoccous fruit, adhere more naturally to *Hedyotis*. Their third division of this group appears strictly referable to that genus. Their remaining species may compose a subgenus of the same; but the dehiscence and the calyx, produced beyond the ovary into a merely 4-toothed or 4-cleft cup or limb, decidedly separate them from *Houstonia*. In the latter, the calyx is adnate up to the origin of the lobes. So it is in

Kadua, Cham. & Schlecht., a genus of more or less shrubby plants, natives of the Sandwich Islands, which was also reduced to the compound genus *Hedyotis* by Endlicher. Through the smaller and subherbaceous species, it does indeed nearly approach *Kohautia*. From this and from all the other related genera, *Kadua* may be technically distinguished by the somewhat salient or reduplicate edges of the lobes of the corolla in æstivation, and by the inflexion of their tips in all but two of the species, which again are well characterized by their winged seeds. The seeds, moreover, are compressed in *Kadua*, (not depressed or obcompressed,) packed side by side, and attached by one edge, not by one face. The capsule, also, is hard and firm, and tardily dehiscent, except by the transverse chink at its naked summit, in some species perhaps slightly drupaceous before maturity; which led the founders of the genus wrongly to refer hither two baccate species, then imperfectly known, — as has already been mentioned.

Meyen's genus *Weigmannia* is only *Kadua cordata;* and what is described and figured in the Reliquiæ Meyenianæ as a single large seed in each cell evidently consists of a mass of seeds closely packed upon the placenta.

The two wing-seeded species would fall into the subtribe *Cinchoneæ*, according to the prevalent arrangement, which also too widely separates *Bouvardia* from *Houstonia*, &c.; but there are other cases known in the family of winged and wingless seeds occurring in the same genus. *Rhombospora* of Korthals seems to be another Hedyotideous plant, referred to the *Cinchoneæ* upon this sole technical character. Indeed, even the whole distinction between baccate, drupaceous, and capsular fruits in the polyspermous *Rubiaceæ* is in many cases so indecisive, that in their classification it may answer better to proceed still farther in the direction already indicated by Mr. Bentham, and to take the primary characters from æstivation, placentation, and stipulation, rather than from the texture of the fruit and the surface of the seeds.

The following conspectus of the species of Kadua exhibits the diversities which this genus presents: —

KADUA, *Cham. & Schlecht.*

§ 1. Flores in cymam terminalem thyrsumve congesti: folia coriacea.

* Semina alata! Plantæ centranthoideæ, thyrsifloræ, subglaucæ, basi tantum frutescentes; foliis subsessilibus rigidis lineato-costatis; lobis calycis breviusculis; corollæ lobis æstivatione haud inflexis: capsula apice haud producto fere plana.

1. K. CENTRANTHOIDES, *Hook. & Arn.* Glaberrima: folia ovato-lanceolata seu cordata-ovata: stylus etiam glaber!

2. K. GLOMERATA, *Hook. & Arn.* Inflorescentia floresque pubescentes: folia caulina oblongo-lanceolata.

* * Semina complanata, scobiformia, nunc marginata vel subalata.

3. K. CORDATA, *Cham. & Schlecht.* Weigmannia glauca, *Meyen.* Habitus inter præcedentes et sequentes: folia superiora et floralia subcordata, ea cymulas glomeratas involucrantia: lobi calycis ovato-lanceolati ovario bis longiori, capsulam fere hemisphæricam vertice planiusculam excedentes.

* * * Semina immarginata, compresso-angulata: corollæ lobi in alabastro apice inflexi.

+ Caules suffrutescentes, 1 – 2-pedales; calyces majusculi. *Kohautiæ* affines.

4. K. COOKIANA, *Cham. & Schlecht.* Gracilis, juncoidea, pauciflora; foliis anguste lanceolatis linearibusve rigidis nervuloso-reticulatis; calycis lobis subulato-lanceolatis ovarium longe superantibus; capsulæ vertice libero conico.

5. K. PARVULA, *Gray, l. c.* Glaberrima; ramis gracilibus usque ad apicem foliosis; foliis coriaceis utrinque lucidulis conformibus (un-

ciam longis) ovato-lanceolatis acutis, inferioribus petiolatis summis sessilibus, venis primariis inconspicuis; floribus paucis (5 – 7) in cymula terminali; calycis lobis lato-lanceolatis tubo corollæ dimidio brevioribus capsula turbinata vertice subplana æquilongis.

6. K. GLAUCIFOLIA, *Gray, l. c.* Glaberrima; ramis usque ad cymam sessilem multifloram foliosis; foliis subcoriaceis ovato-lanceolatis imisve lanceolatis acute acuminatis breviter petiolatis (summis sessilibus) subtus glaucis penninervis; calycis lobis subulatis tubo corollæ gracilis multoties brevioribus capsula fere hemisphærica vertice convexiuscula paullo brevioribus.

+ + Frutex sat altus: calycis lobi ovario breviores e capsula vertice libero convexo vel conico demum decidui.

7. K. MENZIESIANA, *Cham. & Schlecht.* Hedyotis coriacea, *Smith.* H. conostyla, *Gaudich.* Kadua Smithii, *Hook. & Arn.*

§ 2. Flores axillares, imo supra-axillares: calycis lobi magni, solitarii bini vel terni: pedunculi filiformes, fructiferi nutantes: corolla viridula seu alba, limbo amplo, lobis acuminatis apicibus in alabastro inflexis: ovarium tetraquetrum: semina angulata: frutices foliosi: folia laxe penninervia sæpius membranacea.

8. K. ACUMINATA, *Cham. & Schlecht.* Glaberrima; ramis gracilibus; foliis lanceolatis sensim acuteque acuminatis breviter petiolatis, junioribus subsessilibus; calycis lobis anguste lanceolatis.

9. K. PETIOLATA, *Gray, l. c.* Ramosa, glabra; foliis oblongo-lanceolatis oblongisve subito acuteque acuminatis basi plerumque acutis longe petiolatis laxe venosis; calycis lobis lanceolatis seu triangulari-lanceolatis capsulam late turbinatam subæquantibus.

Var. OVALIFOLIA: major; foliis ovali-oblongis (3 – 4-pollicaribus), venis crassioribus.

10. K. GRANDIS, *Gray, l. c.* Foliis amplis oblongis ovalibusque breviter acuminatis perspicue penninerviis longiuscule petiolatis, junioribus ad costam venasque sæpius pubentibus; calycis lobis foliaceis ovato-lanceolatis capsula late turbinata acute 4-costata æquilongis; corollæ lobis tubum adæquantibus.

Species exclusæ: — *K. Romanzoffiensis,* Cham. & Schlecht. = *Gouldia Romanzoffiensis.* *K. affinis,* Cham. & Schlecht. = *Gouldia Sandwicensis.*

Professor Gray also presented the following communication: —

Notes upon some Polynesian Plants of the Order Loganiaceæ. By Asa Gray, M. D.

These will naturally enough follow the foregoing notes upon *Rubiaceæ.*

1. *Geniostomeæ* (*Geniostoma* and *Labordea*).

Under the name of *Hæmospermum*, Reinwardt, Blume long ago correctly described the pulpy placentæ of *Geniostoma*, which enclose the seeds and fill the cells of the fruit. It is remarkable that this should have escaped the notice of succeeding authors, even of Alphonse De Candolle, when he reduced *Hæmospermum* to a species of *Geniostoma* upon the authority of an authentic specimen; and of Bentham, when he recently revised the *Loganiaceæ*,* and had Blume's detailed character of *Geniostoma* before him; † especially as in dried specimens the seeds all cohere in a mass, and are covered with a pellicle of dried pulp, which, when soaked, promptly swells up and encloses the seeds, just as they doubtless are enclosed in the fresh fruit. It appears from a supplementary note to Mr. Bentham's paper, that this structure has been noticed by M. Bureau, in his inaugural dissertation upon this group of plants (which I have not seen); but I do not well understand what is meant by "the curious expansions of the placenta" in a "regular stellately-lobed form." I am confident that there are no distinct *arilli* severally enclosing the seeds, in the manner of *Podophyllum*, but an equable pulpy development of the placenta. In this light it is questionable if Bentham's *G. fagræoides* (the flowers of which are unknown) is really a *Geniostoma*. Although the pericarp is capsular, the analogy of *Geniostoma* to *Gardenia* and the *Randieæ* in the placentation is not to be overlooked, especially as the æstivation of the corolla is similar. To this there are exceptions, however. Good as characters of æstivation are in *Rubiaceæ*, and as they are likely to be in these "*Rubiaceæ* with a free ovary," we can never trust implicitly to the difference between the imbricative and the contorted or convolute. No one can be more aware of this than Mr. Bentham, who will not be surprised to learn that this distinction between the second and third sections of his tribe *Euloganieæ* is untenable, — *Geniostoma rupestre* having occasionally the æstivation assigned to *Logania*, namely, with

* In Journal of the Proceedings of the Linnæan Society, Vol. I. 1857.

† In Mus. Bot. Lugd.-Bat., Vol. 1, p. 238, 1850.

one lobe wholly exterior in the bud, while an unpublished Tahitian species exhibits, in the few flower-buds we have for examination, a regular quincuncial imbrication. That third section may, however, be confirmed by admitting the nature of the placentæ to a leading place in the character.

The ovules of *Geniostoma* are amphitropous, as suggested by Endlicher, rather than anatropous, as stated by Blume; but the seeds become almost anatropous. The minute embryo assigned by Blume, and figured in his *G. lasiostemon*, is not borne out by *G. ligustrifolium* and *G. ruprestre*, both of which have the cylindrical embryo nearly as long as the albumen, as remarked by Alphonse De Candolle in the Mauritian *G. ovatum.*

The corolla, as remarked by Bentham, is not at all funnel-form, but almost rotate, — in fact, between rotate and campanulate. The phrase "*corolla subinfundibuliformis*" found its way into the generic character from Forster's figure of the flower of *G. rupestre*, which represents the tube of the corolla much too long. It is really so short that Sprengel, describing an original specimen, calls the corolla "*subrosacea pentapetaloidea.*" The fine pubescence on the lobes is variable in the same species, or even wanting. The villosity of the throat also varies in amount in different forms of *G. rupestre*, in some cases being reduced to a small tuft at the insertion of the short filaments, or merely upon them; in one of our species it is wholly wanting.

The stigma, I believe, is capitate throughout the genus, or at first depressed-globose, after anthesis sometimes becoming obovate. Here, again, Forster's "*stigma cylindricum*" — utterly at variance with his figure, and that, in turn, doubtless incorrect as to the strong lobulation — has given rise, on the one hand, to De Candolle's "*stigma crassiusculum,*" on the other, to Endlicher's "*stigma sulcatum.*" Sprengel's "*stigma capitatum, pubescens, sublamellosum,*" is better, and would be better still without the last word. While occupied with the pistil of *G. rupestre*, I may remark that the difference between Forster's character "*stylus filiformis tubo longior*" and his figure (*d*), which exhibits a very short style (such as Sprengel terms "*brevissimus*"), is in fact exemplified in what I regard as different forms of this species; — the style being often twice or thrice the length of the ovary and the stigma, and sometimes reduced in length even to a minimum. As to Sprengel's "*stylus basi villosus,*" that was probably suggested by Forster's figure; but that was intended to represent the whole pistil, and the villous hairs are placed, not upon the base of the style, but around the ovary, — indeed, they belong to the corolla.

The inflorescence is axillary throughout the genus. This is stated by Blume only; but De Candolle specifies the axillary flowers under almost every species.

The species of our Polynesian collections are evidently three, viz.: —

Geniostoma ligustrifolium, A. Cunn., of New Zealand, known by its didymous or bicapitate stigma, and its triangular pointed stipules.

Geniostoma rupestre, *Forst.;* a polymorphous species, to which I should refer, not only Blume's *G. Hæmospermum*, but probably Bentham's *G. crassifolium*, at least the variety *glaberrimum*, and even a plant which has the calyx assigned to *G. Cumingianum*, Benth. Our forms of the species — besides the typical one, which is smooth, and with rather small and pointed leaves, like those of the New Zealand species — may be arranged under the varieties *ellipticum*, *macrophyllum*, and *puberulum*. The species may be known from the last by the transversely truncate stipules, and the entire stigma, raised on more or less of a style, never absolutely sessile; nor is the corolla wholly glabrous within, as in

Geniostoma astylum (*Gray, l. c.*): glaberrimum; stipulis truncato-bifidis; foliis ovalibus; sepalis ovatis; corolla intus glabro æstivatione quincunciali!; stigmate integro subgloboso sessili; fructu immaturo anguste oblongo. — Tahiti, Society Islands.

The specimen in the Hookerian herbarium from the Sandwich Islands referred by Bentham to his *G. crassifolium*, β. *glaberrimum*, if really from those islands, is likely to belong to a species which on the whole is better placed in the genus

Labordea. Judging from the plate in the Botany of Freycinet's Voyage, Bentham presumed the æstivation of the corolla of this imperfectly known genus to be valvular, and the fruit to be baccate. The first point would seem to have been verified by M. Bureau, who, according to Mr. Bentham's supplementary note, "has been enabled to dissect three flowers of this plant [*Labordea fagræoidea*, Gaudich.]. He confirms the presumed valvular æstivation of the corolla, but always finds two cells only to the ovary, and very plausibly suggests that the three-celled one examined by Gaudichaud was accidentally abnormal." Now, the herbarium of the South Pacific Exploring Expedition contains good flowering specimens of what I cannot doubt is Gaudichaud's *L. fagræoidea* (notwithstanding two discrepancies in the details which are probably due to mistakes of the artist), and fruiting specimens of another and nearly related species, which negative both these presumptions, while they reveal the true affinity of the genus. That is to say, in our flowering plant the lobes of the corolla in æstivation decidedly, though narrowly, overlap in the convolute manner, and are slightly twisted towards the observer's left. Probably the flower-buds examined by Bureau were too young to show the æstivation properly. Also our fruiting plant is tricarpellary, in all the specimens we possess, and, which is of more consequence, the fruit is a capsule, just like that of *Geniostoma*, except in being trimerous, — the placentæ equally pulpy, and the seeds nidulant. *Labordea*, therefore, ranks next to *Geniostoma*, from which, so far as these materials show, it would seem to be very well distinguished by its Gærtneroid habit, the long and foliaceous divisions of the calyx, the tubular (instead of rotate-campanulate) corolla, the elongated club-shaped (instead of globose or didymous) stigma, and the terminal inflorescence. The occasional, if not the usual, tricarpellary ovary is at most a subsidiary distinction. It is not constant in *L. fagræoidea*, and it can hardly be expected to be so in the allied species. But the same collection (and also Remy's, of later date) has supplied complete materials of a third species, which almost exactly fills the interval between these two genera. For, with the general habit and foliage, and the dicarpellary ovary of *Geniostoma*, it combines the hypocrateriform corolla, the clavate stigma, and the terminal inflorescence of *Labordea*. The form of the corolla, taken with that of the stigma, will surely outweigh that of the calyx, and the terminal inflorescence affords a better distinction than the occasionally trimerous gynæcium. So we must annex this ambiguous species to *Labordea*, unless we merge the latter genus in *Geniostoma*, which at present would hardly be warranted. The known species are : —

LABORDEA (GENIOSTOMOIDES) TINIFOLIA (*Gray, l. c.*) : glaberrima ; ramis gracilibus ; foliis oblongis chartaceis longiuscule petiolatis ; cyma pedunculata composita laxiflora ; calycis segmentis triangulari-ovatis acutissimis tubo corollæ hypocraterimorphæ triplo brevioribus ; stylo gracili ; stigmate elongato-clavato ; capsula globosa bivalvi. —

Sandwich Islands, in Kauai, Maui, Oahu, and Hawaii (coll. Expl. Exped., and coll. Remy).

Labordea fagræoidea (Gaudich.): glabra, pallida; foliis obovato-oblongis oblongisve basi in petiolum breviusculum attenuatis penninerviis subcoriaceis; cyma sessili quasi umbellato-contracta; calyce amplo fere 5-secto, sepalis lanceolatis foliaceis nervosis corollæ tubum subæquantibus; stigmate elongato subclavato; ovario 2 – 3-loculari. — Our specimens are from Hawaii. On the same island was gathered an imperfect fruit-bearing specimen, possibly of this very species, but the vestiges of the calyx are much smaller, and the leaves are larger and somewhat pubescent. Of the fruit, I can only say that it is narrower than in the next, and bivalvular. Perhaps it is a distinct species, but the materials are insufficient.

Labordea sessilis (*Gray, l. c.*): foliis subsessilibus crasso-coriaceis lineato-venosis oblongis seu lanceolato-oblongis, junioribus subtus ramisque pube brevi fusca hirsutis; sepalis oblongo-lanceolatis; capsulis brevissime pedunculatis trivalvibus. — Oahu; in fruit only.

2. *Fagræa.* The two Polynesian species of this genus in the collection are interesting as offering additional points of similarity with *Lisianthus* and related *Gentianaceæ.* They are, *F. Berteriana,* Gray, which, with the corolla of *F. Zeylanica,* though smaller, (yet sometimes with the tube three inches long,) has the bilamellar stigma of *Lisianthus!* This is not mentioned in the character published in Bentham's revision of the genus. The other species, which is mentioned by Bentham, but not characterized, has the placentæ so strictly parietal and sessile, that they appear like four placentæ approximate in two pairs, after the manner of some *Gentianeæ* and *Orobancheæ.* It has no distinct stipules. It is as impossible, therefore, to draw a marked line of distinction between *Loganiaceæ* and *Gentianaceæ* on the one hand, as between them and *Rubiaceæ* on the other. So true is it, that *Loganiaceæ* are not so much an order *per se,* as a *nexus,* binding together four otherwise very distinct orders. — The new Feejean species may be thus characterized: —

Fagræa gracilipes (*Gray, l. c.*): foliis lato-ovatis subcoriaceis obtusis vel apiculato-acutis basi in petiolum longum abrupte decurrentibus; cyma terminali sessili multiflora foliis multo breviore; calyce parvo; corolla e tubo angusto superne late obconico-ampliata; staminibus subexsertis; stigmate capitellato; ovario prorsus uniloculari, placentis arcte parietalibus. — Feejee Islands.

3. Finally, there is a new Polynesian genus, doubtless Loganiaceous, although the corolla and consequently the stamens are unknown. It is remarkable for having an indehiscent, nucumentaceous, or possibly subdrupaceous, club-shaped fruit, on which account it does not fall into either of Bentham's four tribes. It is dedicated to Joseph P. Couthouy, Esq., the zealous Conchologist of the Expedition of which the plant is one of the fruits.

COUTHOVIA, Nov. Gen.

Calyx 5-partitus; segmentis rotundatis crassis imbricatis intus basi biglandulosis? Corolla et stamina ignota. Ovarium liberum, ovatum, calyce subinclusum, stigmate sessili apiculatum, biloculare. Ovula in placentis crassis, medio dissepimento adnatis, plurima, amphitropa. Fructus lignosus, maturus forte subdrupaceus, clavatus vel fusiformis, basi stipitiformi calyce parvo persistente stipata, bilocularis, indehiscens. Semina haud visa. — Frutex vel arbor Vitiensis, *Fagrœa* facie, stipulis vaginatis *Labordeæ;* cyma terminali; floribus parvis.

Couthovia corynocarpa (*Gray, l. c.*). — Ovolau and Sandal-wood Bay, Feejee Islands.

Four hundred and seventieth meeting.

October 11, 1859. — Monthly Meeting.

The President in the chair.

The Corresponding Secretary read several letters relative to the exchanges of the Academy.

Professor Felton presented, from the Hon. George P. Marsh, a circular letter in behalf of the new dictionary of the English Language undertaken by the Philological Society of London.

Professor Felton also exhibited a series of recent photographs from Athens, representing different views of the Parthenon, and some sculptures discovered upon the Acropolis in the course of excavations made during the present year.

Professor Lovering presented a memoir upon the Secular Periodicity of the Aurora Borealis; in which he referred to the manuscript records of the Academy as follows: —

It is well known that Dr. Holyoke, of Salem, kept a Meteorological Journal from 1754 to 1828. That part which relates to the weather has already been published in the Memoirs of the Academy. I have consulted the manuscript records of Dr. Holyoke, which he presented to the Academy, and have selected from them all the instances he has recorded of auroras observed by him. Unfortunately, the copy which the Academy possesses is not the original, until the year 1786; and, being prepared for a special purpose, does not contain any record of auroral appearances until that year. But the Academy possesses the original manuscript Journal of Meteorology kept at Cambridge by Professor John Winthrop, from 1742 to 1779; and also that of Professor Edward Wigglesworth, also kept at Cambridge, from 1782 to 1793; and that of Dr. Enoch Hale, kept in Boston, from 1818 to 1848. In all these Journals, except the last, the auroras are noted with great care; and they altogether cover more than a century, in which only two years are wanting, namely, 1780 and 1781. From this storehouse I have been able to collect 501 recorded examples of auroras, of which only 92 are duplicates; these being subtracted, there remain 409 independent auroras, of which 400 have never before appeared in print. Professor Winthrop has recorded 116 exhibitions of the aurora, Professor Wigglesworth 123, and Dr. Holyoke 262. As these observations have been made at two places only a dozen miles apart, they are strictly comparable with each other, and furnish an almost uninterrupted record of the aurora for one hundred years in this immediate vicinity. The result of my discussion of these observations is, that during the thirty-three years from 1793 to 1827 there are only 17 recorded examples of the aurora. For the thirty-three years preceding 1793 there are 336; and in several instances, a single year of the latter epoch furnishes more cases than the whole of the former epoch; and in one year (1789) there are more than twice as many exhibitions of the aurora as in the whole thirty-three years next preceding 1827."

Dr. B. A. Gould laid before the Academy a circular from the Berlin Academy of Sciences, proposing the establishment of a foundation in memory of Humboldt, for the promotion of scientific travels, &c.

Professor Peirce made a communication upon the Zodiacal Light.

Professor Agassiz stated that, during his recent visit to Switzerland, interesting discoveries had been made in a railroad cutting on the shores of Lake Neufchatel, and in the bed of the lake, at a period of unusual lowness of the water, of a quantity of Celtic utensils, along with the remains of many animals not existing in the vicinity, or even in Europe, at the present time. Among them were stone hatchets, closely resembling those of the North American Indians; and other implements with handles made from the horns of the European deer, now extinct in that vicinity; also, bones of the wild boar, which now exists only in the eastern and northern parts of Switzerland; and, in other places along the shore, remains of pottery, bronzes, &c., indicating several different social states at different periods.

Professor Gray communicated the *Diagnosis of the Species of Sandal-wood (Santalum) of the Sandwich Islands*: —

The species of *Santalum* inhabiting the Sandwich Islands are of considerable interest, inasmuch as they furnish the celebrated sandal-wood, formerly exported from those islands in considerable quantities, and not yet exhausted, though the supply is much diminished.

Although gathered long ago by Menzies, *Santalum Freycinetianum* and *S. ellipticum* were first made known and imperfectly discriminated by Gaudichaud. Hooker and Arnott afterwards proposed a third species, *S. paniculatum*, which is evidently no more than a variety of *S. Freycinetianum* growing in drier or more exposed places. Indeed, it is questionable whether *S. ellipticum* is not likewise a mere variety of that same species, so polymorphous in foliage, of which Gaudichaud's *S. Freycinetianum*, as figured in the Botany of Freycinet's Voyage, is probably the most narrow-leaved form. For the present it may suffice to give such diagnoses as I am able to draw up, from the examination of a full suite of specimens, of these two species, if such they be, and of a third and more distinct species, well marked by its larger drupe with a strongly rimose or ruminated putamen, which was discovered by the naturalists of Captain Wilkes's Expedition on the island of Kauai.

1. Santalum Freycinetianum (*Gaudich.*): foliis coriaceis ovalibus obovato-oblongisve in petiolum brevem basi angustatis; cymis

plerumque terminalibus paniculatis; perigonii tubo obconico, lobis ovatis; drupa ovoideo-globosa (haud semi-pollicari), putamine læviusculo. — Oahu and Hawaii.

Var. LATIFOLIUM: arborescens; foliis magis coriaceis brevius petiolatis late ovatis ovalibus vel subrotundis; cyma densiflora. — S. paniculatum, *Hook. & Arn., Bot. Beech. Voy.* p. 94. — Craters of Hawaii and Maui.

2. SANTALUM ELLIPTICUM (*Gaudich.*): foliis chartaceis ellipticis oblongis seu ovali-obovatis, petioli gracili; cymis paniculisve sæpius axillaribus; perigonii tubo brevi, lobis ovatis; fructu *S. Freycinetiani.*

3. SANTALUM PYRULARIUM (*Gray in Bot. Expl. Exped. ined.*): foliis subcoriaceis oblongis supra lucidis venulosis subtus glaucis, petiolo gracili; cymis sæpius axillaribus; perigonii tubo cylindraceo, lobis oblongis; drupa pyriformi (cum pedicello incrassato pollicari), putamine valde ruminato-rimoso. — Kauai, Sandwich Islands.

Professor Gray also communicated a paper (read by title at the Annual Meeting), being, —

Characters of New Algæ, chiefly from Japan and Adjacent Regions, collected by Charles Wright in the North Pacific Exploring Expedition under Captain John Rodgers. Communicated by Request of the Commander of the Expedition. By Professor WILLIAM H. HARVEY, of Dublin University.

1. SARGASSUM (SCHIZOPHYLLA) PINNATIFIDUM: caule compresso distiche pinnato, pinnis e margine egredientibus; phyllodiis linearibus profunde pinnatifidis, laciniis paucis (2–4) costatis argute serratis vel foliorum superiorum integris; vesiculis ellipsoideis folio sæpe bipartito serrato coronatis; receptaculis longissime laxeque racemosis cylindraceis inermibus.

Loo Choo Islands.

2. SARGASSUM (HOLOPHYLLA) FILICINUM: caule filiformi longissimo (basi ignoto); ramis sæpius secundis; foliis longe petiolatis lineari-oblongis tenuibus profunde pinnatifidis, laciniis alternis linearibus truncatis apice bi–tridentatis; vesiculis sphæricis folio pinnatifido coronatis; receptaculis siliquæformibus apice ramulorum solitariis.

East coast of Japan.

3. Sargassum (Holophylla) Ringgoldianum: caule compresso pinnatim ramoso, ramis horizontalibus complanatis ancipitibus flexuosis pinnatim compositis, pinnulis angulatis; foliis lanceolatis integerrimis verticalibus crassis basi attenuatis immerse costatis, junioribus subenerviis; vesiculis magnis oblongo-ellipsoideis ad basin ramulorum solitariis folio coronatis; receptaculis racemosis junioribus inermibus.

East coast of Japan, and at Simoda.

4. Sargassum (Holophylla) Rodgersianum: (caule ignoto) ramis ad ortum retrofractis? compressis flexuosis pinnatim decompositis, ramulis decompositis; foliis omnibus patentissimis angustissime linearibus immerse costatis subenerviis integerrimis; vesiculis longe petiolatis sphæricis longissime mucronatis vel folio filiformi 1 – 2-unciali coronatis; receptaculis linearibus inermibus obtusis demum racemosis.

East coast of Japan, floating at sea.

5. Sargassum (Holophylla) siliquastrum? (Ag.), var. pyriferum: (caule ignoto) ramis ramulisque ad ortum retrofractis compresso-planis ancipitibus decompositis, superioribus in ramulis angustissimis desinentibus; foliis inferioribus lanceolatis oblongisve distanter serrulatis immerse costatis, superioribus angustissime linearibus integerrimis subenerviis; vesiculis magnis ad basin ramulorum solitariis pyriformibus longe mucronatis; receptaculis linearibus inermibus denique in ramulo racemosis.

Simoda, Japan, on rocks at low tide.

6. Sargassum (Holophylla) corynecarpum: caule triquetro, ramis ad ortum retrofractis; foliis radicalibus inferioribusque elliptico-oblongis latis subintegerrimis vel repando-dentatis crassis immerse costatis, superioribus ramuliformibus angustissimis costatis paucis; vesiculis magnis ellipsoideis mucronatis; receptaculis clavatis plano-compressis inermibus emarginatis racemosis.

Simoda, Japan.

7. Sargassum (Carpophylla) assimile: caule tereti lævissimo; foliis e basi valde obliqua cuneata oblongis obtusis minute glandulosis argute dentatis nervo infra apicem evanescente costatis; vesiculis in petiolo sursum compresso ipsis vix breviori sphæricis muticis; receptaculis foliiferis sæpius furcatis, laciniis integerrimis vel remote denticulatis.

Loo Choo Islands, in tide-pools.

8. Cystophyllum fusiforme: radice ramoso; frondibus ex collo in caules plures divisis; caulibus indivisis tereti-compressis, ramis lateralibus undique egredientibus crebris brevibus ramulis subfasciculatis onustis, ramulis lineari-fusiformibus utrinque acutis medio sæpe vesiculiferis; vesiculis fusiformibus; receptaculis ignotis.

Var. β. clavigerum: ramis ramulo longissimo claviformi infra apicem vesiculifero subtensis, ramulis filiformibus.

On rocks at low tide, Simoda. β. Hakodadi, Japan.

9. Fucus (Fucodium) Wrightii: fronde lato-lineari complanata decomposite dichotoma ramosissima; vesiculis ovalibus v. bilobis in ramis superioribus vel sæpe in axillis ipsis immersis; receptaculis ignotis.

Straits of Sangar, Japan.

10. Fucus (Fucodium) Babingtonii: fronde angustissima compresso-plana decomposite dichotoma fastigiata; vesiculis oblongis angustissimis in ramis superioribus infra axillas immersis; receptaculis linearibus terminalibus simplicibus furcatisve.

Japan (Dr. Babington in Herb. T. C. D.): rocks at Simoda; Hong Kong.

11. Ecklonia Wrightii: stipite brevi robusto compresso apice subpalmatim ramoso (vel crebre dichotomo?); ramis in frondes pinnati-lobatas expansis, laciniis sublanceolatis basi angustatis inæqualiter argute serratis.

Simoda, Japan, on rocks at low tide.

12. Alaria pinnatifida: stipiti ancipite sursum complanato crispato-marginato in costam latam apice desinente; lamina latissima profunde pinnatifido-lobata, laciniis oblongis simplicibus furcatisve sinubus rotundatis, pinnis crassis obovatis brevibus.

Simoda, Japan.

13. Costaria Turneri (Grev.); var. pertusa: stipiti ex radice ramosa plano in laminam longissimam (11 – 12-pedalem) lanceolatam 4-costatam bulloso-inflatam demum foraminibus pertusam expanso.

Straits of Sangar and Hakodadi Bay, Japan.

14. Dictyota obtusangula: fronde anguste lineari incrassata succulenta opaca decomposite dichotoma; axillis omnibus latissime rotundatis; laciniis patentibus divaricatisve, supremis irregularibus, apicibus obtusis nunc multifidis.

Loo Choo and Ousima. (Also common at the Friendly Islands.)

15. Odonthalia obtusangula: fronde plano-compressa in parte superiori immerse costata lineari alterne decomposita, ramis distantibus patentibus plus minus compositis junioribus sæpe margine denticulatis, ramulis alternis furcatis corymbosis erectis, laciniis ultimis anguste subulatis; axillis omnibus rotundatis apicibusque acutis.

Straits of Sangar, Japan; floating.

16. Rytiphlœa complanata (Ag.); var. pusilla: fronde nana complanata anguste lineari flabelliformi subfastigiata pinnatim decomposita, pinnis erecto-patentibus crebris pl. m. pinnatis, pinnulis subulatis alternis. — An. sp. distincta?

Hakodadi, Japan.

17. Chondria crassicaulis: fronde crassissima succulenta vage ramosa, ramis sparsis vel subverticillatis incrassatis flexuosis basi constrictis, ramulis sparsis fasciculatisve claviformibus obtusissimis basi valde constrictis; cystocarpiis? — *Laurenciæ*, sp.? Harv. in Alg. Morrow, Japan Exped.

Japan: Simoda, *Dr. Morrow;* Hakodadi.

18. Polysiphonia Stimpsoni: fronde capillari rigidiuscula vage ramosa; caule ramisque primariis corticatis arcuatis, ramis secundariis horizontaliter patentibus divaricatisque subsecundis brevibus parum ramulosis articulatis, ramulis subulatis patentibus, articulis diametro æqualibus vel brevioribus 4-siphoniis, geniculis opacis; ceramidiis?

Japan; dredged in Hakodadi Bay by *Mr. Stimpson*, the zoölogist of the Expedition.

19. Polysiphonia calacantha: fronde fucescente capillari 4-siphonia ecorticata vage ramosa, ramis sparsis flexuosis linearibus simpliciusculisque per totam longitudinem ramulis brevissimis quadrifariis horizontalibus divaricato-multifidis spinulosis confertissime onustis, articulis brevissimis; spinulis ramulorum apice fibrilliferis. (*Polysiph.* no. 13, Harv. Alg. Ceylon.)

Loo Choo Islands, and Tanegasima, Japan, south of Kiu-siu.

20. Polysiphonia flabellulata: pusilla, nigrescens; fronde capillari flaccida brevi repetite dichotoma fastigiata, axillis acutis, apicibus vix attenuatis, articulis 6-siphoniis omnibus diametro brevioribus.

Tanegasima, Japan.

21. Polysiphonia Harlandii: fronde 4-siphonia corticata tessellata setacea parum ramosa fucescente, ramis virgatis simplicibus attenu-

atis, ramulis quoquoversum egredientibus brevibus basi simplicibus nudis apice pluries furcatis fastigiatis, apicibus acutis, articulis ramulorum pellucidis diametro subbrevioribus; tetrasporis sub apice ramulorum solitariis.

Hong Kong.

22. Wrangelia? Tanegana: fronde corticata; ramis quoquoversum egredientibus ramellis densissime vestitis, ramellis brevissimis verticillatis crassis bis terve furcatis mucronatis, articulis ramellorum diametro æqualibus ad genicula valde constrictis.

Tanegasima, Japan. — Fruit unknown: perhaps a *Callithamnion* or *Halurus*.

23. Desmia Japonica: fronde latiuscula compresso-plana subflabelliformi decomposito-pinnata, pinnis irregularibus lato-linearibus, pinnulis inæqualibus subulatis, axillis omnibus rotundatis.

Simoda, Japan; on rocks at low tide.

24. Gracilaria gigas: fronde cartilagineo-carnosa crassissima tereti siccitate collapsa elongata vage ramosa, ramis alternis secundisve longissimis simpliciusculis nudis vel ramulis paucis filiformibus obsessis, axillis rotundatis, apicibus attenuatis.

Simoda, Japan; on rocks at low tide.

25. Gracilaria eucheumioides: fronde primaria decumbente crassissima compressa vage et parce ramosa, ramis clavæformibus simplicibus vel apice furcatis compressis nudis vel hic illic tuberculis onustis tunc erectiuscula pl. m. pinnatim ramosa, apicibus obtusis. (Harv. Alg. Ins. Amic. no. 35.)

Ousima, and the proper Loo Choo Islands.

26. Suhria Japonica: fronde costa crassissima percursa lineari (prolificationibus a costa et margine emissis) decomposite ramosa, margine integerrimo; sporophyllis? sæpius varie lobatis, apicibus obtusissimis.

Simoda, Japan.

27. Caulacanthus compressus: fronde pusilla dichotomo-multifida fastigiata, laciniis primariis sursum latioribus compressisque, stipite ramulisque teretibus, axillis rotundatis, ramulis spinæformibus sparsis patentibus simplicibus ramosisve.

Loo Choo Islands; in rock-pools.

28. Galaxaura distenta: fronde tenui subcompressa continua

nitida decomposite dichotoma fastigiata, laciniis infra axillas cuneato-dilatatis complanatis, axillis obtusis, apicibus perfossis.

Ousima, north of the Loo Choo group.

29. GYMNOGONGRUS LIGULATUS; var. ANGUSTUS: fronde stipitata plano-compressa rigide cartilaginea flabelliformi lineari dichotoma, axillis distantibus patentibus, ramis linearibus obtusis apice sæpe proliferis.

Simoda, Japan; on rocks at low tide.

30. GIGARTINA LANCIFOLIA: stipite tereti-compresso ramoso; ramis basi compressis subcanaliculatis apice in folia lanceolata plana ciliata utrinque spinulis conspersa desinentibus.

Hakodadi Bay, Japan; on rocks at low tide.

31. GIGARTINA AFFINIS: stipite tereti-compresso dichotomo; ramis frondes dichotomo-decompositas fastigiatas gerentibus, segmentis margine incrassatis subcanaliculatis pluries furcatis, laciniis linearibus, apicibus obtusis; papillis nullis? (Aff. *G. mamillosæ.*)

With the preceding.

32. GIGARTINA TENELLA: fronde pusilla compressa anguste lineari disticha ramosa, ramis alternis sparsisve arcuatis attenuatis, ramulis paucis subulatis patentibus sæpius secundis, apicibus acutis.

Kaikai-sima, north of the proper Loo Choo group.

33. HALOSACCION (HALOCŒLIA) JAPONICUM, Harv. (charac. emendato): fronde simplicissima cartilaginea rigida basi et apice attenuata ramulis crebris patentibus filiformibus densissime obsessa.

Hakodadi, Japan.

34. HALOSACCION (HALOCŒLIA) WRIGHTII: fronde tenui-membranacea flaccida simpliciuscula basi et apice attenuata pinnatim ramosa, pinnis pinnulisque patentibus utrinque attenuatis acutis subdistichis.

Hakodadi, Japan.

35. HALOSACCION (HALOCŒLIA) INTESTINALIS: fronde clavato-intestinæformi longissima simplicissima basi attenuata apice obtusissima coriacea; strato peripherico crasso filis verticalibus constituto tetrasporas oblongas includente.

Arakamtchetchene Island, within Behring's Straits.

36. GLOIOPELTIS COLIFORMIS: fronde intestinæformi membranacea (filo centrali mox evanido) cava et inflata subsimplici basi et apice

attenuata nunc apice prolifera nunc furcata; cystocarpiis numerosissimis.

Japan (*Dr. Babington*): Hakodadi and Straits of Sangar.

37. Endocladia complanata: fronde ex stipite tereti mox compressa tunc complanata decomposite dichotoma, laciniis lato-linearibus vel cuneatis ex margine et disco ramulos spinosos emittentibus margine fimbriatis.

Simoda, Japan; on rocks near high-water mark.

38. Caulerpa Amicorum: surculo crassiusculo glabro; ramis erectis basi nudis vage decomposite ramosis ramulis virgatis, ramentis bi–trifariis subulatis incurvis acutis, inferioribus brevissimis conicis, (Harv. Alg. Ins. Amic. no. 62.)

Ousima, north of the proper Loo Choo Islands. (Friendly Islands, of larger size.)

39. Caulerpa brachypus: surculo glabro; phyllodiis subsessilibus elliptico-oblongis basi et apice obtusissimis planis enervibus integerrimis nunc hic illic constrictis vel proliferis.

Tanegasima, Japan.

HALICORYNE, Harv. (Nov. Gen.)

Frons calcareo-incrustata, claviformis, simplex, ex axi tubuliformi monosiphonio continuo ramulisque verticillatis saccatis unicellulosis demum sporiferis constituta. Sporæ ex materia viridi ramulorum vetustorum formatæ, numerosæ, sphæricæ, nucleo denso viridi in peridermide hyalino membranaceo incluso. — Alga habitu *Dasyclado* proxima, fructu substantiaque diversa.

40. Halicorynne Wrightii. — Loo Choo Islands; in muddy pools, at low tide. Thinly incrusted with carbonate of lime.

41. Valonia Forbesii: cellula maxima pyriformi incurva basi in stipite infundibuliformi attenuata.

Loo Choo Islands. (Also Ceylon.)

42. Enteromorpha cærulescens: fronde cærulescente membranacea longissime tubulosa vage ramosa, ramis filiformibus attenuatis simiplicibus, ramulis sparsis setaceis.

Loo Choo Islands; in stagnant pools of fresh water.

43. Cladophora Wrightiana: maxima, ultra setacea; fronde stipitata rigide membranacea robusta trichotoma, ramis bis terve divisis

discretis erectis, ultimis virgatis; ramulis oppositis ternisve appressis 1 – 2-cellulosis; articulis inferioribus diametro multoties ramulorum 5 – 10-plo longioribus ad genicula constrictis; apicibus obtusis.

Simoda, Japan; in rock-pools at low water.

44. Cladophora Stimpsoni: cæspitosa, capillaris; fronde tenuimembranacea flaccida læte virente di – trichotoma, axillis majoribus distantibus patentibusque, ramis pluries furcatis, ramulis ad ramos minores superiores sæpius pectinato-secundis longiusculis; articulis inferioribus longissimis filiformi-cylindraceis; ramulorum diametro 5 – 8-plo longioribus ad genicula subconstrictis; apicibus subacutis.

Hakodadi Bay, *Mr. Stimpson.*

45. Cladophora densa: dense cæspitosa, fastigiata; fronde basi radicante erecta stipitata biunciali capillari rigidiuscula dichotoma; ramis pluries furcatis erectis, superioribus alternis sparsisve, amulis paucis; articulis primariis longissimis, cæteris diametro 5 – 10-plo longioribus ad genicula constrictis; apicibus obtusis.

Hakodadi Bay, Japan; on rocks at half-tide.

46. Cladophora fastigiata: cæspitosa, nigro-viridis, basi radicans; filis vix uncialibus setaceis rigidis strictis trichotomis pluries divisis fastigiatis, ramis ramulisque omnibus oppositis erectis vel appressis; articulis diametro 8 – 10-plo longioribus, apicibus obtusis.

Loo Choo Islands.

47. Cladophora oligoclada: cæspitosa, lætevirens, mollissima, lubrica; filis elongatis (3 – 4-uncialibus) capillaribus parcissime vage et distanter ramosis, ramis longissimis simpliciusculis, ramulis secundis brevissimis unicellulosis; articulis ramorum diametro 4 – 6-plo longioribus materie viridissima repletis pellucido-marginatis.

Loo Choo Islands.

48. Cladophora uncinella: pusilla, uncialis, densissime cæspitosa, lætevirens; filis trichotome ramosissimis capillaribus rigidiusculis; ramis primariis secundariisque oppositis, penultimis ramulisque falcato-secundis crispatis; ramulis valde hamatis; articulis primariis diametro pluries ramulorum 4 – 5-plo longioribus; geniculis contractis.

Ousima, north of the proper Loo Choo Islands.

49. Cladophora polaris: cæspitosa, lætevirens, mollis, nitida; filis capillaribus strictissimis decomposite ramosis; ramis ramulisque erectis (axillis angustissimis), superioribus clavato-incrassatis succu-

lentis obtusissimis; articulis inferioribus diametro 2 – 3-plo supremis multoties longioribus.

Semiavinia Bay, Arctic Asia. (Also at Whalefish Islands, Davis's Straits, and in the Arctic Ocean, lat. 76°, *Dr. Lyall.*)

50. Rivularia opaca: fronde (minori) vesiculosa difformi rigida opaca nigro-viridi; filis moniliformibus laxiusculis.

Loo Choo Islands.

51. Lyngbya atrovirens: cæspitibus longe fluitantibus atrovirentibus comosis; filis crassiusculis liberis glaucis densissime striatis; vagina crassa subopaca sæpe rugosa.

Loo Choo Islands.

52. Lyngbya effusa: cæspite effusa nigro-viridi; filis semiuncialibus tenuibus intricatis flexuosis glaucis; vagina angusta lævi.

Loo Choo Islands. An obscure production.

53. Lyngbya atropurpurea: cæspite atropurpurea comosa; filis tenuissimis fluitantibus strictiusculis violaceis, striis inconspicuis. (Harv. Alg. Ins. Amic. no. 118.)

Bonin Islands; on corals. (Also at the Friendly Islands.)

54. Chroolepus Chinensis: majuscula, rupestris; filis in cæspite (2-unc.) tomentosa luteo-viridi siccitate pallide glaucescenti intertextis decumbentibus vage ramosis; ramis horizontaliter patentibus recurvis sæpius secundis; ramulis paucis multisve patentibus; sporidiis lateralibus sparsis; articulis diametro duplo longioribus.

Hong Kong; on damp rocks in the mountains.

Four hundred and seventy-first meeting.

November 9, 1859. — Stated Meeting.

The President in the chair.

The Corresponding Secretary read several letters relative to the exchanges of the Academy.

He also read a "Note upon the Allanite found at East Bradford, Pennsylvania, by William Sharswood, A. M."

Professor Gabriel Valentin, of Berne, Switzerland, was elected a Foreign Honorary Member in Class II. Section 2 (Botany).

The following Associate Fellows were elected: —

Professor George C. Swallow of Columbia, Missouri, in Class II. Section 1 (Geology, Mineralogy, and Physics of the Globe).

Hon. Samuel G. Arnold, of Providence, in Class III. Section 3 (Political Economy and History).

Edward B. Hunt, U. S. A., in Class I. Section 3 (Physics and Chemistry).

The following Fellows were elected: —

Calvin Ellis, M. D., in Class II. Section 4 (Medicine and Surgery).

Theodore Lyman, in Class II. Section 3 (Zoölogy and Physiology).

E. S. Ritchie, in Class I. Section 3 (Physics and Chemistry).

Professor Lovering inquired whether the following extracts from Winthrop's History of New England do not indicate the appearance of the Aurora in this country at a much earlier date than that assigned to it in Holmes's Annals: —

"About midnight three men, coming in a boat to Boston, saw two lights arise out of the water near the north point of the town cove, in form like a man, and went at a small distance to the town, and to the south point, and there vanished away." "The like was seen by many, a week after."

In the second case: —

"A light, like the moon, arose about the northeast point in Boston, and met the former at Nottles Island, and there they closed in one, and then parted, and closed and parted divers times, and so went over the hill in the island and vanished. Sometimes they shot out flames, and sometimes sparkles."

This was on the 11th and 18th of April, 1643.

Professor Lovering, in behalf of the Committee of Publication, made the following report in regard to the printing of Part I. of Volume II. of the Old Series of Memoirs, ordered by the Academy at the last annual meeting.

The Committee had directed 200 copies of this Part to be printed. They had also found it necessary to print 200 copies of Judge Davis's Eulogy upon Washington, belonging to the second part of the same volume. This republication will enable the Academy at once to realize 92 complete sets of the First Series of Memoirs; and the reprint hereafter, when the necessity arises, of another small portion, will make complete 100 more sets. For there are in the possession of the Academy 237 copies of Volume I. There are only 3 copies of Volume II. There are 18 additional copies of Part II. of that volume. There are also 100 additional copies of Part II., with the exception of Judge Davis's Eulogy on Washington. There are besides 68 extra copies of Plate I., 27 extra copies of Plate II.; and the stone on which the illustration of Dighton Rock is drawn is also in possession of the Academy. Of Volume III. there are 57 complete copies. Then there are 64 separate copies of Part I. and 35 of Part II. Of Volume IV. there are 245 complete copies; and, in addition, 3 of Part I. and 78 of Part II.

As the 24 additional pages to be printed, and the supply of three woodcuts and a lithographed plate, have made the cost of republication exceed by $50 the appropriation for this special purpose ($200), the committee recommend that a subscription paper be opened to members of the Academy for complete sets of the Old Series of Memoirs, at $3 a volume, or $12 the set. If 20 sets were purchased, the cost of republication would be repaid to the Academy, and 72 complete sets would remain immediately available.

Dr. Jenks gave an account of the organization of a literary and scientific society at Shanghae.

Dr. J. B. S. Jackson exhibited a portion of a glass tube which was accidentally broken while drawing a sponge through to clean it; one piece of which exhibited a very regular spiral crack running from end to end.

Professor W. B. Rogers said he thought the direction of the crack might result from an equality between the cohesive attraction of the particles in a transverse and longitudinal direction, causing the line of fracture to follow the diagonal of these forces.

Professor Lovering suggested whether the nodal lines of acoustic vibration had anything to do with the phenomenon.

Professor Peirce made an elaborate communication on the tides.

Professor W. B. Rogers gave an account of some experiments which he had been making on the phenomena of subjective vision, to settle the question whether the two eyes combined successively the different points of an object, as Brewster supposed, or obtained an instantaneous recognition of all parts at the same moment.

Mr. F. H. Storer read by title a "Memoir on the Alloys of Copper and Zinc."

He also presented the following communication: —

On the Detection of Chromium in Presence of Iron.

It is customary, in the methods of analysis now most commonly employed in laboratories of instruction, to rely upon the solvent action which the caustic alkalies exert upon hydrated sesquioxide of chromium as a means of separating this base from the oxides closely allied to it. It is well known, however, and the experiments of Northcote and Church* have determined the fact quantitatively, that when a small amount of sesquioxide of chromium is accompanied by a large quantity of the oxides of manganese, cobalt, nickel, or of sesquioxide of iron, it ceases to be soluble in the alkalies. From the frequency of its occurrence, as well as from the fact that it has the power of concealing a larger amount of chromium than either of the other bases which have been mentioned, the sesquioxide of iron in particular gives rise to much inconvenience in practice. It is a constant source of annoyance to beginners, who almost invariably fail to detect the presence of chromium in solutions containing it given them for analysis, if these at the same time contain iron also. In this case it may be detected, it is true, by fusing the mixed precipitate of oxide of iron and of chromium with nitrate of potash and carbonate of soda, and examining the aqueous solution of the mass obtained for chromic acid; but the student seldom applies this test, unless specially directed to do so. The operation is troublesome, since it necessitates the employment of a special

* Qu. J. Chem. Soc., VI. 53.

set of tools, and occupies considerable time. It is as a rule distasteful to the student, and is rarely resorted to even by experienced analysts, unless the color of the solution, a preliminary blowpipe test, or some incidental observation, has already indicated the probable presence of chromium in the substance under examination.

It is obvious, that if the chromium in the mixed precipitate could be oxidized in the wet way by some simple and rapid method, it would not only be more readily detected in any case, but the chances of overlooking it altogether — an event now so liable to occur — would be materially lessened.

Frommherz * long ago noticed that chromic acid is formed when an aqueous solution of a salt of chromium is treated with a solution of permanganate of potash, — a fact which has since been corroborated by Reynoso,† and still more recently by Cloez and Guignet.‡ Reynoso has suggested, moreover, that this reaction may be employed for the detection of chromium, especially if the chromic acid formed be subsequently converted into Barreswil's perchromic acid.

Chancel,§ on the other hand, has observed that chromic acid is formed when sesquioxide of chromium is heated with solution of caustic potash in presence of peroxide of lead; as may be shown by acidifying the filtrate from this mixture with acetic acid, chromate of lead being precipitated. He has also proposed ‖ that this reaction shall be used as a test for the detection of chromium.

After a number of experiments upon the subject, I have satisfied myself that peroxide of lead is as good an agent as any at our disposal, if it is not the best, for effecting the oxidation of sesquioxide of chromium by the wet way, while the formation of perchromic acid is unquestionably the most delicate and characteristic reaction for chromic acid which we possess. This note, therefore, must be considered as being merely supplementary to the statements of Chancel and Reynoso.

Besides the observations of these chemists are those of Balard,¶

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* Schweigger's Journal f. Ch. u. Phys., 1824, XLI. 281.

† Ann. Ch. et Phys., 1851, (3), XXXIII. 324.

‡ Comptes Rendus, XLVII. 712.

§ Comptes Rendus, XLIII. 928.

‖ *Loc. cit*, and Précis d'Analyse Chimique Qualitative, par Gerhardt et Chancel, (Paris, 1855,) pp. 112, 289.

¶ Ann. Ch. et Phys. (2), LVII. 266.

that oxide of chromium is immediately changed to chromic acid when treated with a solution of hypochlorous acid; and of Carney,* who has found that chromic acid is produced when a galvanic current is caused to flow through a dilute solution of caustic alkali in which sesquioxide of chromium, even that which has been ignited, is suspended.

For my own part, I have observed that sesquioxide of chromium may be converted into chromic acid in the wet way by the agency of several substances besides those already mentioned, and that the presence of free alkali, so far from being necessary, as has been implied by previous observers, with the exception perhaps of Frommherz, is not by any means essential in most instances to the success of the operation, oxidation occurring very readily in several cases in strongly acid solutions.

A dilute solution of chrome alum — which by experiment was ascertained to contain no chromic acid — was acidulated with sulphuric acid, a little peroxide of lead was added, and the whole boiled; on filtering, the solution was found to be of a yellow color, and readily afforded the reaction of chromic acid when tested with dilute solution of peroxide of hydrogen, viz. a magnificent blue coloration due to the formation of perchromic acid.

A solution of permanganate of potash, acidulated with dilute sulphuric acid, being substituted for the peroxide of lead in the preceding experiment, produced a similar result. Peroxide of manganese also replaces perfectly the peroxide of lead in this experiment.

It is not even necessary that these mixtures should be heated. Dilute solution of chrome alum, acidulated with sulphuric acid, and mixed with a small portion of peroxide of lead, having been allowed to stand in the cold, was found to contain traces of chromic acid at the end of half an hour; after standing eighteen hours, a considerable quantity of chromic acid had formed.

A similar solution, in which peroxide of manganese was used instead of the peroxide of lead, gave a fine reaction of chromic acid at the end of eighteen hours.

A quantity of solution of permanganate of potash, acidulated with dilute sulphuric acid, having been added to a dilute solution of chrome alum, also acidulated with sulphuric acid, retained its purple color after

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* Proceedings of Boston Society of Natural History, VI. 409.

having stood in the cold during twenty-four hours; at the end of this time, bits of paper were introduced in order to destroy this color, after effecting which, the solution was tested: it contained no inconsiderable amount of chromic acid.

The foregoing experiments were all repeated, with almost absolutely identical results, with solutions prepared by dissolving chemically pure hydrated sesquioxide of chromium in dilute sulphuric acid. The formation of chromic acid in the cold may have been a little less rapid in this case than in the experiments with chrome alum; the mixture containing peroxide of lead, however, afforded an abundance of it when tested after having stood two hours, and still more at the end of twenty-four hours. That containing peroxide of manganese also gave a fine reaction of chromic acid after standing twenty-four hours. The trial with acidulated permanganate of potash was not tested until the purple color of the solution had disappeared; this was found to have occurred after the expiration of forty-eight hours; the solution was then yellow, and afforded the reaction of chromic acid.

Sesquioxide of chromium, dissolved in dilute nitric acid, is also converted into chromic acid when the solution is boiled with peroxide of lead, with peroxide of manganese, or with a solution of permanganate of potash acidified with dilute nitric acid; minium produced the same result, though somewhat more slowly. This action is much less rapid in the cold; the sample tested with permanganate of potash contained chromic acid after having stood during twenty-four hours; the solution to which peroxide of lead had been added assumed a decided yellow color, and afforded the reaction of chromic acid after standing three or four days; but the portion which had been mixed with black oxide of manganese gave no indication of chromic acid when examined at the end of the fifth day.

When dilute chlorhydric acid is used, instead of the sulphuric or nitric acids of the preceding experiments, similar results are obtained; at least with peroxide of manganese and with solution of chameleon mineral, both in the cold and when heated. With peroxide of lead, however, the results are less satisfactory. I have not been able to obtain any decisive indication of the formation of chromic acid in this experiment, but at the same time am not sure that minute traces of it may not have been present. The conversion of the peroxide into chloride of lead apparently interferes with the production of chromic acid.

In concentrated sulphuric acid sesquioxide of chromium is evidently slowly converted into chromic acid by the action of peroxide of lead, even in the cold, since the solution becomes yellow after standing eighteen or twenty-four hours. This action is very rapid if the mixture be heated, a fine yellow solution being obtained at once. I have, nevertheless, found it somewhat difficult to prove the presence of chromic acid in this solution, since it appears to be decomposed when diluted with water.

With peroxide of manganese, a yellowish solution is also readily obtained by boiling. In the cold, no reaction could be perceived at the end of five days.

When a solution of sesquioxide of chromium in concentrated sulphuric acid is boiled with a small quantity of chlorate of potash, chromic acid is formed. With very dilute sulphuric acid, this does not at once occur; but after boiling for some time, the acid becomes more concentrated, and a portion of the chromium is then oxidized. Nitrate of potash produces no similar result when used instead of the chlorate in this experiment.

When dissolved in concentrated nitric acid, sesquioxide of chromium is slowly oxidized by peroxide of lead in the cold, abundant indications of it having been obtained at the end of eighteen hours. The reaction occurs at once if the acid be boiled. Minium also, when boiled with solution of sesquioxide of chromium in concentrated nitric acid, rapidly converts it into chromic acid. With peroxide of manganese, no chromic acid was obtained, either by boiling or after standing in the cold during a week. When a solution of sesquioxide of chromium in concentrated nitric acid is boiled with a small quantity of chlorate of potash, the chromium is rapidly and completely converted into chromic acid. With very dilute nitric acid this does not occur. Nitrate of potash having been substituted for the chlorate in this experiment, no chromic acid was formed.

With concentrated chlorhydric acid and the above-mentioned oxidizing agents, only negative results were obtained. As a general rule, it is not easy to oxidize sesquioxide of chromium in the presence of free chlorhydric acid, — a fact which accords with the well-known reducing action exerted by this acid upon solutions of chromic acid or of its salts.*

* *Vid.* Rose, Handbuch der analytischen Chemie, I. 355 (Braunschweig, 1851).

When dissolved, or merely suspended in dilute aqueous solutions of the fixed alkalies, sesquioxide of chromium is readily converted, even in the cold, into chromic acid, by the action of the peroxide of lead and of manganese, by permanganate of potash, and with peculiar rapidity and completeness by Bromine. The application of heat favors the reaction in each of these instances. Iodine, also, at least when the mixture is heated, appears to behave like bromine; the oxidation is, however, much less rapid. Chromic acid is also formed when red oxide of mercury or hypochlorite of lime is heated with a mixture of sesquioxide of chromium and solution of caustic alkali; none was obtained by the action of stannic or of arsenic acid, nor can minium be used in place of peroxide of lead, since it does not appear to exert any oxidizing action upon sesquioxide of chromium when in presence of the alkalies.

When mixed with ammonia, oxide of chromium is readily oxidized by peroxide of lead, peroxide of manganese, or by solution of chameleon, the free alkali of which has been neutralized, if heat be applied. A similar oxidation also occurs, though slowly, in the cold. With bromine no chromic acid was obtained, — a result not at all surprising, in view of the violent reaction which occurs when this substance is mixed with ammonia.

In studying the reactions which have just been described, I was met at the outset by the difficulty that none of the tests for chromic acid — viz. precipitation of sparingly soluble chromates of the metallic oxides — which are in common use were sufficiently delicate for the purpose. Indeed, besides the yellow color of solutions of the chromates, which is of course far from being characteristic, there is no test for traces of this acid which is susceptible of rapid and general application, excepting the formation of perchromic acid by means of peroxide of hydrogen. Having, like Reynoso, been compelled to resort to this reaction, I have found it incomparably more sensitive and characteristic than any of the other tests for chromic acid. Taken in connection with the yellow color of solutions containing chromates, it affords a test of remarkable delicacy. It depends, in brief, upon the fact, that when a solution containing chromic acid is poured into a *dilute* * solution of per-

* It is of the first importance that the solutions used should be dilute, since no perchromic acid is formed in concentrated solutions; or if formed, it is decomposed again instantly.

oxide of hydrogen, perchromic acid is formed; this imparts a beautiful, though exceedingly evanescent, blue color to the solution. The perchromic acid is soluble in ether, which removes it from its solution in water without injuring its color, which indeed disappears far less rapidly from the ethereal than from the aqueous solution.

The details of the process to be followed in applying this test may be found in Barreswil's Memoir upon Perchromic Acid.*

I have obtained satisfactory results by operating as follows. A solution of impure peroxide of hydrogen is prepared by triturating peroxide of barium with water in a porcelain mortar, and pouring the thin paste obtained by small portions into a quantity of common chlorhydric acid, which has previously been diluted with four or five parts of water, the latter being agitated meanwhile with a glass rod. The solution thus obtained may be kept for a considerable time without undergoing change. I have not, for that matter, noticed any decomposition in those with which I have operated.

A piece of peroxide of barium as large as a pea is more than sufficient to prepare 150 cubic centimetres of the solution. In testing, some six or eight cubic centimetres of the solution of peroxide of hydrogen are to be placed in a narrow test-tube, and covered with a layer of ether about half a centimetre in thickness. The solution suspected to contain chromic acid is now to be poured little by little into the solution of peroxide of hydrogen, the tube which contains the latter being closed with the thumb, and gently inverted after each addition, so that the ether may dissolve the perchromic acid as fast as it forms. All violent agitation of the mixture is to be avoided, since it tends to hasten the destruction of the blue color. The result of the test can hardly be deemed satisfactory, unless a blue ethereal solution is obtained, for many of the salts of chromium impart a bluish-purple color to their aqueous solutions. Since this color is persistent, however, it cannot be confounded in any case with the fugitive blue of perchromic acid, although it might at times conceal the latter so long as it remained dissolved in the water; for the rest, it is absolutely insoluble in ether.

One or two experiments regarding the delicacy of the reaction may be mentioned in this connection. A solution containing one part of

* Ann. Ch. et Phys. (3), XX. 364.

normal chromate of potash in 20,000 parts of water afforded a perfectly distinct blue ethereal solution of perchromic acid, when tested with peroxide of hydrogen as above described. A solution of one part chromate of potash in 30,000 parts of water also gave a distinct reaction, though the blue color was less deep than in the preceding experiment. With 40,000 parts of water the reaction was faint, though still discernible; as much so, perhaps, as the yellow of the aqueous solution of the chromate.

I have also detected, by means of this test, the presence of chromic acid in the aqueous solution of a bead, of ordinary size, obtained by fusing sesquioxide of chromium with borax in a loop of platinum wire in the oxidizing flame of the blowpipe. Plattner * had already supposed that the yellowish color, which compounds of chromium impart to borax in the oxidizing flame, was due to formation of chromic acid. It is doubtful, however, whether the fact has been previously experimentally proved.

Several experiments have also been made in order to ascertain whether the presence of peroxide of iron would interfere with the oxidation of the sesquioxide of chromium. Weighed portions of protosulphate of iron were boiled with nitric acid in order to oxidize the iron, and mixed with weighed portions of chrome alum; the solutions were then treated with a slight excess of caustic ammonia, and boiled. After washing the precipitates formed, they were subjected to the action of oxidizing agents.

I have operated upon mixtures composed of: —

No. 1.

Grammes.			Grammes.	Per cent.
3.00	$FeO\,SO_3 + 7\,aq$	$= Fe\,O_{1\frac{1}{2}}$	0.8633 or	84.81
+				
1.00	$KO\,SO_3;\ Cr_2O_3,\ 3\,SO_3 + 24\,aq$	Cr_2O_3	0.1546 or	15.19

No. 2.

Grammes.			Grammes.	Per cent.
3.00	$FeO\,SO_3 + 7\,aq$	$= Fe\,O_{1\frac{1}{2}}$	0.8633 or	91.78
+				
0.50	$KO\,SO_3;\ Cr_2O_3,\ 3\,SO_3 + 24\,aq$	Cr_2O_3	0.0773 or	8.22

No. 3.

Grammes.			Grammes.	Per cent.
5.00	$FeO\,SO_3 + 7\,aq$	$= Fe\,O_{1\frac{1}{2}}$	1.4389 or	97.38
+				
0.25	$KO\,SO_3;\ Cr_2O_3,\ 3\,SO_3 + 24\,aq$	Cr_2O_3	0.0387 or	2.62

* Probirkunst mit dem Loethrohre, von Plattner, (Leipzig, 1853,) S. 144.

No. 4.

Grammes.			Grammes.	Per cent.
10.00	$FeO\,SO_3 + 7\,aq$	$Fe\,O_{1\frac{1}{2}}$	2.8777	or 98.73
+ 0.25	$KO\,SO_3;\ Cr_2O_3,\,3\,SO_3 + 24\,aq$	Cr_2O_3	0.0387	or 1.27

No. 5.

Grammes.			Grammes.	Per cent.
20.00	$FeO\,SO_3 + 7\,aq$	$Fe\,O_{1\frac{1}{2}}$	5.7554	or 99.33
+ 0.25	$KO\,SO_3;\ Cr_2O_3,\,3\,SO_3 + 24\,aq$	Cr_2O_3	0.0387	or 0.67

Portions of the precipitate produced by ammonia in each of these solutions were dissolved in chlorhydric acid, and a part of this solution was treated with an excess of cold potash lye of sp. gr. = 1.305; an excess of caustic soda of sp. gr. = 1.07 being added to another portion. After standing in the cold, out of contact with the air, during eighteen hours, the alkaline mixtures were filtered, and the filtrates thoroughly boiled. No precipitate of sesquioxide of chromium was produced in any of them, nor did these filtrates afford any chromic acid when boiled with peroxide of lead.

Other portions of the moist original precipitates were dissolved in chlorhydric acid, and these solutions treated with a slight excess of dilute caustic soda. A small quantity of peroxide of lead was now added to the mixture, and the whole thoroughly boiled during two or three minutes. On filtering, yellow-colored solutions were obtained in every instance, and on testing these with peroxide of hydrogen the characteristic reaction of chromic acid was very distinct in each.

The oxide of chromium in other portions of all of the original precipitates was also readily oxidized by boiling them with bromine in presence of free alkali, as well as by dissolving them in concentrated nitric acid, and boiling this solution with chlorate of potash. The presence of chromium was, moreover, readily detected in Nos. 1 and 2 by boiling a mixture of precipitate and alkali with peroxide of manganese, or with permanganate of potash; but as these substances are evidently less conveniently applied than the others which I have mentioned, no further experiments were made with them.

It should perhaps be stated, that the experiments upon the precipitate from mixture No. 5 were made upon portions of it weighing two or three grammes, the entire weight of the moist precipitate being something more than a hundred grammes.

Among the various agents capable of oxidizing oxide of chromium when in presence of sesquioxide of iron, it is not at first sight easy to decide which one should be preferred to the others for common use. Bromine in presence of the alkalies appears to be the most powerful of them, but since the acid solution of peroxide of hydrogen, which is used in testing, would react upon any bromide which might have been formed in the alkaline solution, bromine would be liberated, and, by imparting its color to the ether, would obscure the reaction. A similar objection applies of course to iodine. This difficulty is easily overcome by neutralizing the alkali with nitric acid, and boiling for a few minutes to expel the bromine: an objection to this process, however, is the fact that the solution is considerably diluted thereby.

Chlorate of potash, with concentrated nitric acid, is in some respects a very convenient agent: objections to it are, that some of the products of the decomposition of the chlorate which remain in the solution, appear to interfere with the formation of perchromic acid; moreover, if any nitrate of chromium remain unoxidized in the solution, it will impart a bluish-purple tint to the aqueous solution of peroxide of hydrogen, which, though insoluble in ether, often interferes very materially with the detection of the color of perchromic acid, if only traces of the latter are present. This remark applies to any process of oxidation in which nitric acid is employed. Both of these difficulties can generally be avoided by diluting the nitric acid solution with water, and using a quantity of ether somewhat larger than is usually necessary. In any case where hyponitric acid is generated, it dissolves in the ether, and may conceal the blue color of perchromic acid.

Black oxide of manganese is not only a less energetic oxidizing agent than peroxide of lead, but the chromate formed in its presence does not color the solution so strongly. The latter remark applies also to permanganate of potash, another objection to which is the necessity of destroying its own color whenever it has been used in excess, before testing for chromic acid.

On the other hand, the reagent of Chancel, peroxide of lead, is capable, as I have shown, of oxidizing sesquioxide of chromium, even when in presence of an enormous excess of peroxide of iron. It has none of the disadvantages of the other substances to which allusion has been made, and is especially to be preferred, since the chromate formed in its presence imparts an intense yellow color to the alkaline solution.

It must be remembered, however, that this coloration, although a very delicate, is by no means a *characteristic* test,* and that the presence of even considerable quantities of chromic acid cannot be detected in the solution by the methods in common use. For example, the yellow-colored filtrate obtained after having boiled a portion of the precipitate from mixture No. 3 (which contained more than 2.5 per cent of sesquioxide of chromium) with a solution of caustic soda and some peroxide of lead, was slightly acidified with acetic acid, care being taken not to dilute the solution unnecessarily. No precipitate was formed even after the lapse of forty-eight hours; the solution still retained its yellow color, however, and afforded a fine blue ethereal solution when treated with peroxide of hydrogen. Even in experiment No. 1, the yellow alkaline solution of chromate of lead gave no immediate precipitate when neutralized with acetic acid, nor did any appear until after the lapse of considerable time.

When concentrated alkaline solutions are used in conjunction with the peroxide of lead, it is best to acidify them, before testing with peroxide of hydrogen, since the reaction might otherwise be disturbed. This is not necessary, however, when dilute alkali is used.

The methods of oxidizing chromium which have been discussed in this article are of course applicable to a great variety of cases. I have only specially treated of the one in which this oxide is concealed by an excess of peroxide of iron, since an improvement upon the ordinary processes seems to be peculiarly needed in this instance. It will be found, however, that, with the exception of the blowpipe tests, none of the methods for the detection of chromium which are now in use can be compared with the one herein proposed.

An apparent objection to this process is the doubt which suggests itself whether peroxide of hydrogen may not be capable, under some circumstances, of producing perchromic acid when mixed with solutions, not only of chromic acid, but also of simple sesquioxide of chromium. It is indeed somewhat strange that this should not be the case. I have not, however, been able to effect such transformation, although I have made a large number of experiments with solutions and mixtures of the sesquioxide in the mineral acids and in alkalies, under the most varied conditions as regards their temperature

* It is probable that by the use of the prism, as proposed by Gladstone (Qu. J. Ch. Soc., X. 79), these colored solutions might be satisfactorily tested for chromic acid.

and state of concentration. In short, I have seen nothing which militates in the least against the accuracy of the test.

It is true that, when peroxide of barium is itself added to a solution of sesquioxide of chromium in caustic alkali, and the whole is boiled, a certain quantity of chromic acid is obtained. I have not been able to procure any, however, by operating in the cold.

With caustic ammonia and peroxide of barium, the chromium is gradually converted into a violet ammonia-chromium base in the cold. On boiling the original mixture, a quantity of chromate of baryta is formed. But when in solution in acids, sesquioxide of chromium does not appear to be converted into chromic acid by the action of peroxide of barium, either in the cold or when heated.

Four hundred and seventy-second meeting.

November 22, 1859. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters of acceptance from the Hon. S. G. Arnold of Providence, and Captain E. B. Hunt, United States Engineer, who were elected Fellows at the last stated meeting.

Mr. C. B. Elliott read a paper upon

The Influence of Legislation on Registration in Massachusetts.

The results in the following table are deductions from data furnished by the Annual Reports of the Secretary of the Commonwealth, relating to the registry and return of births, deaths, and marriages in Massachusetts for the seven years from May 1st, 1841, to April 30th, 1848 (inclusive); for the nine years from January 1st, 1849, to December 31st, 1857 (inclusive); and from data furnished by the national enumerations of the population of the State made in the years 1840 and 1850, and the State enumeration of 1855.

The table exhibits the ratios of the births, the deaths, and the marriages, registered in each of the years above mentioned, to the population, estimated for the middle of each year. Also, the average of each class of these ratios for the *two* years immediately preceding the operation of the act of the Legislature approved in 1844; the average for the *five* years intervening between the operation of the act of 1844 and that of 1849; and the average for the *eight* or for the *nine* years following the act of 1849. It also presents, for comparison with the foregoing, like ratios for one hundred and sixty-six towns of Massachusetts in 1855, which towns comprise about two thirds of the population of the State, and which were selected, as furnishing trustworthy data, as the basis of the construction of a Life Table for the State.* The table also shows the greatest, the least, and the average ratios for England for the nineteen years 1838 – 56, the period during which an efficient system of registration has there been in operation.

Inspection of these results shows that the passage of the acts of 1844 and 1849 produced an immediate and marked influence on the completeness of the returns; and also that the ratios, when not disturbed by legislative enactments, remain comparatively constant, year by year. These observations lead to the conviction, that, by judicious legislation at the present time, the returns for the year 1860, and all subsequent years, may be rendered so perfect, that cases will seldom or never escape notice.

The ratios of the births, deaths, and marriages actually occurring in the State to the population of the State, probably do not greatly differ from those indicated by the returns of the one hundred and sixty-six towns in 1855; that is, *thirty-one* (31.2) births, *twenty-one* (21.4) deaths, and *twelve* (12.4) marriages to every thousand persons living. It will be observed that the legislation of 1844 *improved* the record of births, but rendered still more defective the record of deaths and of marriages; the average of the annual ratios of the number of births to one thousand persons living, advancing from eleven to eighteen, but that of deaths receding from thirteen to eleven, and that of marriages from seven to six. The legislation of 1849 appears to have improved the returns of each of the three classes of events; advancing the average of the rates of registered births from eighteen to twenty-nine, of registered deaths from eleven to eighteen, and of registered marriages from six to eleven to every thousand persons living.

Accepting the returns of the one hundred and sixty-six selected towns of 1855 as furnishing just *standards* for comparison, it appears

* See Proceedings of American Association for the Advancement of Science, Montreal Meeting, 1857, p. 51.

that during the eight years 1850 – 57, *eight* per cent of the births, and *ten* (10.5) per cent of the marriages, and during the nine years 1849 – 57, *fourteen* per cent of the deaths occurring in the State *escaped registration.* These deficiencies do not appear to have been uniform throughout the State, many of the towns making apparently full and trustworthy returns, while those of other towns are manifestly so incomplete as to be of little value.

Few will be likely to estimate too highly the importance of a perfect system for the registration of the births, the deaths, and the marriages which occur in the State ; — first, historically and judicially, as facilitating the legal descent of heritable property, and as determining the settlements of certain citizens (the latter now a source of frequent and vexatious litigation between towns) ; and, secondly, statistically, as affording fit material for the construction of life tables, not only for the entire State, but also for different localities, classes, and pursuits, and for the solution of many practical questions, the interest of which is not limited to the people of our own State or hemisphere.

Ratios of the Births, Deaths, and Marriages, annually registered in Massachusetts, to 1000 *Persons living at the Middle of each Year ; also, the Average, the Greatest, and the Least Ratios for England for the Nineteen Years* 1838 – 56.

Year.	Births.	Deaths.	Marriages.	Number of Report.
May 1, 1841, to April 30, 1842, inclusive,	11.1	12.3	7.4	I.
1842 – 3	10.9	13.3	7.3	II.
Act approved March 16, 1844.				
1843 – 4	17.9	10.3	5.2	III.
1844 – 5	18.3	10.3	5.7	IV.
1845 – 6	18.7	10.5	6.0	V.
1846 – 7	18.9	12.1	6.0	VI.
1847 – 8	17.8	12.1	5.7	VII.
Act approved May 2, 1849.				
1849	26.5	21.0	7.1	VIII.
1850	27.8	16.7	10.4	IX.
1851	28.0	18.5	11.7	X.
1852	28.3	17.6	11.0	XI.

Year.	Births.	Deaths.	Marriages.	Number of Report.
1853	28.6	18.8	11.9	XII.
1854	28.9	19.3	12.4	XIII.
1855	28.9	18.3	10.9	XIV.
1856	29.7	17.8	10.6	XV.
1857	29.7	17.9	9.9	XVI.

	Births.	Deaths.	Marriages.
Average of *two* years before Act of 1844,	11.0	12.8	7.3
Average of *five* years before Act of 1849,	18.3	11.1	5.7
Average of *eight* years, 1850 – 57,	28.7	9 years, 1849 – 57. 18.4	11.1
Massachusetts.			
166 towns, 1855	31.2	21.4	12.4
England and Wales.			
Nineteen years 1838 – 56, Average,	32.9	22.4	8.2
Greatest,	34.5 (1856)	25.1 (1849)	8.9 (1853)
Least,	30.3 (1838)	20.5 (1856)	7.3 (1842)

Professor Peirce explained the principles involved in estimating the actual value of the property of life assurance companies.

Professor G. P. Bond stated that he had received from England a successful photograph of Donati's comet, taken near London by a common camera. It represented the nucleus with a small part of the tail.

Professor Cooke made some remarks upon Mr. Storer's paper on the Alloys of Zinc and Copper (presented at the previous meeting), and illustrated the bearing of the facts determined by Mr. Storer, and of others observed by himself, upon his view of the variation of chemical force.

Four hundred and seventy-third meeting.

December 13, 1859. — Monthly Meeting.

The President in the chair.

Professor James Hall made a detailed communication upon the fossil Crustacea of the genus *Eurypterus*, DeKay, its species, and their geological relations; illustrated by a full suite of specimens, and by drawings.

Professor Agassiz discoursed upon the morphology of the genus *Eurypterus*, and its place in the zoölogical system. He considered it an undoubted member of the family to which Trilobites belong, and of which the genus *Limulus* is the present representative.

Chief Justice Shaw read a paper upon the use of granite as a building material, and upon the introduction of the present mode of working it: —

The discussions which have recently taken place respecting the Hancock House have revived my recollections of the history of stone masonry and the use of granite as a building material in Boston, and offer an occasion for stating what appears to me to have been an important discovery in the art of working granite within a comparatively brief period. It was said, I believe, of a great man of antiquity, as one of his highest claims to the gratitude of his countrymen, that he found the city of brick, and left it of marble. We think that every one feeling just sentiments of pride for the beauty, permanency, and grandeur of the city of his home, in the taste and utility of its public and private buildings, must take a deep interest in knowing the value, cheapness, and excellence of the building materials within its power for practical use. The vast number and magnificence of the granite buildings recently erected in various parts of the city increases the interest we naturally feel, in knowing the steps which have led to this extension of the art, by which granite is brought into use. My main object is to state a fact respecting it which I have never seen stated, which appears to me to be not generally known, and which came to my knowledge under such circumstances as to command my belief.

It is believed that, although granite has always abounded near Boston, it was not till some time in the earlier part of the last century that it was used for the building material of houses, but was used only for wharves, cellars, and wells, where smooth and even walls were not required. It is believed that during the first century of the existence of Boston, when smooth building-stone was required to be used with brick building, as for basements, corners, window-frames, or the like, freestone was used, being the red-sandstone of Connecticut River.

At some time between the end of the first quarter and the middle of the eighteenth century, that is, now a little more than one hundred years ago, the practice of stone-hewing and hammering for the working of granite was first introduced into Massachusetts by German emigrants. It is understood that Brigadier-General Waldo brought a colony of German emigrants from their native country, a large number of whom settled at a place called Germantown, then in the town of Braintree, now Quincy. A large part of this colony proceeded, under the care of General Waldo, to Maine, and settled in a new township thence called Waldoborough, from which many settlers of German origin spread into other towns in Maine.

The Germans who remained in Braintree introduced several branches of the mechanic arts, which had not before been in use in this country. That of stocking-weaving was one; it was there introduced, and has been practised by their descendants until within a few years, if it is not continued to the present time.

Another of the arts was glass-making, which was probably the first establishment of glass-works in this part of the country. They manufactured glass-ware and toys, and it is believed window-glass, though the glass was not sufficiently clear and transparent for good window-glass, and the business was mainly confined to green-glass bottles and other green-glass articles. Many families had quantities of bottles made and stamped with the family name on the bottle. Such a one is there occasionally seen.

But what is more material to my present purpose is, that this class of German artisans first introduced into this country the practice of preparing hewn or hammered stone, wrought to a plain surface, sufficiently straight and smooth to make a regular wall. The process as then practised by them, and those who were instructed by them, was understood to be extremely laborious, and of course expensive, as the expense depended wholly on the amount of labor required for preparing it. Without describing the process precisely, which I do not understand sufficiently to do, I understand the first thing to be done was, if the rock was in a quarry, to blast out a portion of it by gunpowder. By this process, fragments would come out in all sorts of irregular forms, as by mere chance. The business of the workman then was to take the pieces of more regular form, and reduce them to smaller and more regular shapes, as wanted for building. This is done by cutting a groove on a straight line with a hammer made with a cutting edge like that of a common axe, then striking it with a very heavy iron beetle on each side of the groove alternately, until it would crack, generally in the line of such groove. This would sometimes split in a line nearly straight through, though it would often be irregular. In this mode, by dividing and subdividing, the pieces were brought as nearly as practicable to the dimensions required; and then all the irregularities of surface must be removed by hard hewing with very heavy instruments.

In this state of the trade, although stone might be got out and dressed and made suitable for building, yet few buildings were erected, probably on account of the great expense. Some of our older inhabitants may perhaps recollect the stone house at what is now the corner of Tremont and Somerset Streets, long the hospitable mansion of Jeremiah Allen, Esq., a former Sheriff of Suffolk, and celebrated for the number of good dinners given there. There was another granite house on School Street next below the Chapel, owned by John Lowell, Esq., who removed it and erected Barristers' Hall on the same site. But by far the most conspicuous dwelling was the Hancock House, still standing, built by Mr. Thomas Hancock. He was a native of Braintree, became a wealthy merchant, and probably chose to gratify his townsmen and himself by adopting, as the material for his sumptuous dwelling, one of these staples of his native town, without much regard to the cost. He was the uncle of John Hancock, and, dying without children, gave the house to him. Governor Hancock had been erecting a house for himself at the corner of Court and Tremont Streets, but having received from his uncle a gift of the Hancock House, about the time his own was ready for occupation, it is believed he never lived in the one he built.

One other granite building of the same period, the most important of all, remains to be referred to, — the "King's Chapel." This was commenced in 1752 and finished about 1755 or 1756. It was built entirely of hammered stone obtained from the North Common in Braintree, corresponding nearly if not exactly with the present granite quarries in Quincy. It was designed as an Episcopal Church for the accommodation of the king's officers, of the Provincial government, revenue officers, and Provincial gentry; and was intended, in its sumptuous character, to be as near an approximation as possible to an English church, and was very properly denominated the "King's Chapel."

When this work was finished, it was the wonder of the country round. People coming from a distance made it an object to see and admire this great structure. The wonder was that stone enough could be found in the vicinity of Boston fit for the hammer to construct such an entire building. But it seemed to be universally conceded, that enough more like it could not be found to build such another.

The stone-trade and stone-quarrying remained nearly in the same condition, it is believed, until about the end of the last century. Soon after that time, an extraordinary change took place; buildings of wrought granite, both the light-colored granite of Chelmsford and Tyngsboro' and the dark granite of Quincy, were used in erecting private and public buildings; a new spring was given to the business of getting out stone, which has continued to the present time. During the first few years of the present century, many new private buildings were erected; in 1810 or 1811 the Court-House in School Street was built, after a plan by Mr. Bulfinch; in 1814, the church on Church Green, Summer Street, was completed, and many others followed in regular succession up to the present time; and now the city seems rapidly filling with structures of granite of the most sumptuous character.

It becomes a most interesting inquiry to what this great change can be attributed. To call the attention of the public to this point, is the sole purpose of this communication.

I have always understood that the change was caused by the art of splitting granite with small wedges, which was unknown here till about the time in question. This art, apparently not difficult, or requiring any great skill, was yet of so great importance as to facilitate the working of granite, and reduce the cost to such a degree, as to render it a comparatively cheap building material, regard being had to its strength, durability, and beauty.

The process, now so familiar, is a simple one, requiring no complicated apparatus, and no unusual skill or force when once known. But if, as it is supposed, it has produced these great changes, furnished the community with a most excellent building material at a cheap rate, and has filled our city with the permanent and sumptuous structures which are everywhere rising to constitute one of its chief ornaments, it seems an object of laudable curiosity to ascertain its origin and introduction, to learn who invented or first practised it, or whether it was in use elsewhere, and brought here, and by whom.

This brings me to my main purpose, a statement given by the late Governor Robbins of Milton, as to the origin of the art of splitting stone. I give it with all the names and particulars, in order that the statement may be verified, or refuted, by showing another and a different origin of the introduction of this art, or by showing some other mode in which it was invented, or brought here from elsewhere.

Prior to 1798, Castle Island in Boston Harbor, now Fort Independence, was the prison of the State, where convicts were sent to be punished by confinement and hard labor. About that time, the United States, in anticipation of hostilities with the French, were desirous of having possession of Castle Island, in order to erect thereon a strong fortification for the defence of Boston, and for that purpose urged on the Commonwealth the necessity of having immediate possession of the island. The Commonwealth acceded, and caused the prisoners to be removed, although the State prison at Charlestown was not built or ready for their reception, nor was it so for some time after. This fixes the time when the State prison was in the process of building. Governor Robbins of Milton was one of the first Commissioners, and in this capacity put himself into communication with all the workers and dealers in stone, and found their prices very uniform, though, as he thought, very high.

The narrative I am about to state he made to me some twenty years after. I was then one of the agents for the public, in erecting a stone building for the county, and probably that was the occasion of my interview with him. It was this: —

Desirous of getting the stone for the prison on the best terms, and believing the prices high, though general, he thought much and conversed much on the subject. In that state of mind, and deeply interested in the subject of stone, he had occasion to pass through Salem in a chaise. In passing along a street, he noticed a building apparently new, the basement story of which was of stone. He stopped to look at it carefully. In doing so, he perceived along the margin of each stone the marks of a tool at distances of six or seven inches apart. This was something new. He had never seen it on hewn stone. He immediately inquired for the owner, and saw him, and asked if he knew how and by what process those stones were got out and wrought. He said he did not, but referred him to the contractor, who did most of that species of work in Salem, by the name of Galusha. As I took the name by the sound only, the orthography may be different, Galoucia or Galooshy. He then proceeded to find Mr. Galusha, and to ask him whether he got out those stones, and by what process. He said he did not get them out himself; that they were obtained in Danvers, two or three miles distant, and were furnished him by a man named Tarbox. Upon asking for directions to find Mr. Tarbox, Governor Robbins was told that he was a very poor man, being in an obscure situation in Danvers, near the place where the stone was quarried. Governor Robbins, determined to pursue the inquiry, immediately proceeded to Danvers, and, after considerable inquiry, he found Mr. Tarbox, in a small house, with a family, and with every appearance of poverty about him. After some little preliminary conversation, he asked Mr. Tarbox if he got out the stone in question, and if so his method. He told him he had, and immediately proceeded to explain the process, and showed him his tools, his mode of drilling the holes, and inserting and driving the small wedges as above described.

Governor Robbins was at once struck with the idea that it was new and peculiar, and might be a very important invention. Governor Robbins did not say that he asked whether it was an invention of his own, or whether he had learned it of anybody else. But as it was new to himself, I think he was impressed with the belief that it was the invention of Tarbox. He seemed, however, not to feel that he had any exclusive or peculiar interest in the use of this art. Governor Robbins then asked him if he would consent to go up to Quincy and work two or three months and split stone in his mode, so that other workmen might practise it. He said it was impossible for him to leave home; that his family were dependent on him for their daily bread, and that he had no clothes suitable to go from home. Governor Robbins obviated all his objections by making provision for the family during his absence, also engaged to give him two or three times the monthly wages usually paid the best stone-cutters, and the man consented. Having made the necessary arrangements, he took him to a clothing-store in Salem, obtained him a suitable outfit, then took him into his chaise and brought him to Quincy. Governor Robbins added, that he introduced Mr. Tarbox to several of the principal stone-dealers, and that it was not three months before every stone-cutter in Quincy could split stone with small wedges as well as Mr. Tarbox. Also that this improvement in the working of granite had in a very short time the effect to reduce the price to five eighths of its former cost; that is, that the cost of the dimension stone wanted for the prison, which had before been $4.00, was afterwards reduced to $2.50, and other granite work in similar proportion.

I have been thus particular in naming persons and stating circumstances, in the hope that some persons still live, either at Salem or Quincy, who can throw light on the subject. It would be very extraordinary if an art of so much importance should be traced to a source so obscure as poor Mr. Tarbox, who seems to have been hardly conscious that he was doing anything extraordinary. It may be that this whole narrative rests on some mistake, and that a different origin for this art of working granite may be shown; if so, it is very desirable that it should be made known to the public.

Four hundred and seventy-fourth meeting.

January 10, 1860. — Monthly Meeting.

The President in the chair.

The correspondence of the Academy, since the preceding meeting, was read by the Corresponding Secretary.

Professor Agassiz gave a sketch of the plan upon which he is arranging the Museum of Comparative Zoölogy at Cambridge; viz. in separate faunæ, with also an assorted typical collection to illustrate the general systematic arrangement.

Dr. C. T. Jackson exhibited a specimen of meteorite containing olivine or chrysolites, like the celebrated Siberian meteorite of Pallas. The specimen was detached from a large mass, at least five feet in diameter, recently discovered upon the summit of a mountain in Oregon, in the vicinity of Rogue River. Dr. Jackson also exhibited specimens of some other North American meteorites.

Professor Horsford directed attention to instances of spontaneous combustion of saw-dust, used to catch the dripping of oil from machinery.

Professor Jeffries Wyman read a paper on the anatomy, and especially the muscular system, of *Troglodytes Gorilla.*

Mr. Folsom exhibited a specimen of the smallest ancient gold coin known. It bears the head of Jupiter Ammon, and is of an age anterior to B. C. 500. The only other specimen known is in the British Museum.

Professor Agassiz presented his views of the tertiary deposits, as consisting, in each of its three great divisions, of a greater number of successive deposits, and these of a much more distinct character, than is generally thought. He expressed his conviction, not only that the tertiary shells which have been regarded as identical with existing species are specifically different, but also that in some cases shells of successive beds of the same formation, which have been taken for the same, really belong to two, three, or more species.

A discussion respecting the evidences of synchronism between distant deposits of the same epoch ensued between Professor W. B. Rogers and Professor Agassiz.

Professor W. B. Rogers exhibited a stereoscopic slide, which, by a simple contrivance, enabled the observer to rotate two equal slips of ivory on a black ground in such manner as to give them any desired inclination to one another, thereby causing the resultant visual figure to assume various perspective attitudes in the vertical plane, and, by alternate convergence or divergence of the slips, giving it a vibrating motion in that plane. This arrangement he offered as the simplest experimental means of illustrating the principle of visual relief, as produced by combining the twin pictures of a stereoscope. He made some remarks in continuation of former observations in regard to the theory of vision by the successive combination of corresponding points, as maintained by Sir David Brewster, and described a further experiment which he regarded as wholly incompatible with that theory.

The immediate purpose of the experiment is to present to the two eyes the respective component pictures, *not simultaneously*, as in the usual mode of binocular combination, but *in succession* or rapid alternation. This is done most simply by placing one of the common twin drawings, as of a crystal or other solid traced by white lines on a black ground, at a distance of about twice the limit of distinct vision, and, by a proper arrangement, moving backward and forward over the face of the drawing a slip of black pasteboard, so as alternately to cover and expose first one and then the other picture, taking care that no part of one shall be in view while the other is wholly or in part revealed. If, while the moving screen is briskly vibrated, the optical axes be converged to an intermediate point, as in the combination of twin pictures by what has been falsely termed the squinting process, *the observer will see the resultant picture in the same position, and with as complete relief, as if both pictures were permanently uncovered.* As might be expected, the same effect is obtained with pictures viewed in the stereoscope; and in this case the experiment is most readily made with transparent slides and an opaque screen, caused to vibrate or to revolve near the surface of the slide on which the light is received. As in these observations the corresponding points of the twin drawings can never be seen at the same time, it is inconceivable that any adjustments of the optic axes can be made to unite them pair by pair, as is claimed by the theory of Brewster. The resultant binocular perception is here due to *a present picture* in the one eye, combined with the *picture previously made* in the other, and which, by the well-known law of visual sensibility, continues its impression for a short time after the occlusion of the light. But this latter, having been impressed on particular parts of the retina, cannot be shifted to other parts point by point, as would be necessary to effect the combination with the corresponding actual ray-impressions on the other eye. This experiment, therefore, confirms the conclusion drawn by Professor Rogers at a former meeting from observations on the binocular combination of visual spectra, and offers, he thinks, a conclusive argument against the theory maintained by Brewster, and which has been so widely accepted.

Four hundred and seventy-fifth meeting.

January 25, 1860. — STATED MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from Professor George C. Swallow, in acknowledgment of his election as an Associate Fellow of the Academy.

Mr. Chauncey Wright and Mr. Simon Newcomb, of the Nautical Almanac Office, Cambridge, were elected Fellows in Class I. Section 1, Mathematics.

Professor Agassiz, followed by Professors Parsons, W. B. Rogers, and others, discussed several points in natural history and geology in reference to their bearing upon the origin and distribution of species.

Professor Gray communicated, from the author, the following: —

Characters of some New Grasses collected at Hong Kong and Vicinity by Mr. Charles Wright in the North Pacific Exploring Expedition. By COLONEL WILLIAM MUNRO, C. B., &c., of the British Army.

1. BERGHAUSIA MUTICA (sp. nov.): racemo decomposito; pedicellis apice barbatis; *spiculis muticis scabro-puberis; foliis linearibus* utrinque attenuatis margine pilis longis fimbriatis, vaginis glabriusculis apice longe fimbriatis. — An *Miquelia barbata*, Nees in Rel. Meyen.? A *Berghausia patula* differt floribus majoribus, arista nulla, pedicellis etc. multo longioribus et dissitis.

Hong Kong.

2. BERGHAUSIA PATULA (sp. nov.): racemo decomposito; pedicellis apice barbatis; spiculis hirsutis seta simplici basi non torta aristatis; foliis lineari-lanceolatis utrinque attenuatis. — Gluma valde varians. —

Cætera species, omnes Indicæ, sunt *B. Courtallensis*, Arn., et *B. scoparia, polypogonoides*, et *adscendens*, Munro.

Hong Kong.

3. Aristida (Chætaria) Chinensis (sp. nov.): panicula 10–12-pollicari patula exserta, radiis solitariis geminisve usque ad basin bipartitis 1–6-uncialibus nutantibus ad axillas barbatis supra bis dichotomis quandoque axillulis barbatis; ligula ciliata. — Glumæ inæquales, inferiori acuminata 5 lin. superiori sub 3 lin. longa. Flosculus apice non torto nec articulato.

Whampoa and Cum-sing-moon.

4. Apocopis Wrightii (sp. nov.): spica bifida; spiculæ inferioris sessilis gluma externa 8-nervi truncata obtusissima basi flava apice rubro-marginata fimbriata, nervis apice obsoletis; flosculis hermaphroditis omnibus nisi infima aristatis, arista 9-lineali; paleis fl. inf. masc. glumas superantibus. — Aff. *A. Royleanæ*.

Cum-sing-moon.

5. Ischæmum leersioides (sp. nov.): hirsuta; culmo gracili; foliis anguste linearibus; spica simplici unilaterali curvata; gluma spiculæ sessilis inferiori oblonga pectinata (*nec alata*) apice obtusiuscula; spiculis pedicellatis tabescentibus. — Aff. *I. pectinato*.

Whampoa, Lemma Island, and Hong-Kong.

6. Ischæmum ophiouroides (sp. nov.): spica simplici semicylindrica; gluma spiculæ sessilis quadrato-oblonga scariosa alata retusa margine exteriore ciliis perpaucis absconditis pectinato; spiculis pedicellatis tabescentibus; foliis planis brevibus obtusis basi contractis et ciliatis.

Whampoa.

Professor Gray read a paper, entitled,

A Revision of the Genus Forestiera. By Asa Gray.

FORESTIERA, *Poir.*, Genus Oleacearum.

Adelia, *Michx.*, non *P. Browne.* Borya, *Willd.*, non *Labill.* Bigelowia, *Smith*, non aliorum. *Piptolepis*, Benth.

* Folia membranacea, nunquam porulosa vel punctata.

1. F. acuminata (Poir.): glabra; foliis ovato-lanceolatis ovatisve utrinque acuminatis longiuscule petiolatis serrulatis vel subintegerri-

mis; drupa oblonga vel fusiformi sæpius acuminata. — Adelia acuminata, *Michx.*, *Fl.* 2, p. 225, t. 48. Forestiera ligustrina, *Gray*, *Man. Bot.*, ed. 2, p. 358, non *Poir.* — Wet, shady grounds along streams, Georgia to Illinois, Missouri, and Texas.

Var. *β.* PARVIFOLIA: foliis subpollicaribus, primordialibus subspathulatis obtusis, sequentibus pl. m. acuminatis; drupa breviter oblonga plerumque obtusa. — New Mexico; near Santa Fé, *Fendler*, no. 547. Below El Paso, *Wright*, no. 1699. Semeleuque Springs, *Dr. Bigelow*, in Mex. Bound. Coll.

Dr. Torrey, in the Botany of the Mexican Boundary Survey, has passed over specimens of this variety as belonging to *F. ligustrina.* Fendler's specimens clearly show it to be a form of F. acuminata, the fruit of which varies exceedingly in shape.

2. F. LIGUSTRINA (Poir.): molliter pl. m. pubescens; foliis obovatis ovalibus seu obovato-oblongis obtusis serrulatis (pollicaribus et ultra) basi in petiolum brevem angustatis; drupa ovoidea.

Var. *a.* foliis adultis glabratis vel glabellis; drupis subsessilibus. — Rocky banks, Florida to Georgia and Tennessee.

Var. *β.* PUBESCENS: foliis etiam adultis molliter pubescentibus; drupis pedicellatis. — F. pubescens, *Nutt. in Trans. Amer. Phil. Soc. n. ser.* 5, p. 177. Florida, Arkansas, Texas, New Mexico, Chihuahua. (Coll. *Lindheimer*, no. 700, &c.)

In the Botany of the Mexican Boundary Survey, Dr. Torrey has doubtless correctly reduced Nuttall's *F. pubescens* to *F. ligustrina;* but the difference in the length of the fruiting pedicels, unnoticed by him, is worthy of remark.

One or two mistakes of Richard, in Michaux's Flora, have led to confusion in respect to *F. ligustrina* and *F. acuminata*, and to a mistake in my Manual of Botany, which it is one object of this notice to correct. Richard characterizes *Adelia ligustrina* as with "foliis integerrimis," *A. acuminata* with "foliis levissime serratis"; whereas in fact the leaves of the former are always serrulate; but those of the latter are sometimes entire, as indeed they are represented in the figure, which figure, with the character, identifies the species completely. Moreover, *A. acuminata* is said to inhabit Carolina and Georgia, which is true, as to the latter State; *A. ligustrina*, Illinois and Tennessee, which is not the case, at least as to Illinois. In the Manual, following the indication of this habitat, I called our only

Northwestern species *F. ligustrina;* but it is certainly *F. acuminata.* I suppose that the habitats of the two species are transposed in Michaux's herbarium and Flora.

* * Folia coriacea impunctata.

3. F. SPHÆROCARPA (Torr. Bot. Mex. Bound. Surv. p. 168): tomentoso-puberula; foliis parvis (semipollicaribus) oblongis vel ellipticis obsolete crenulatis coriaceis subpetiolatis; drupa globosa pedicello subæquilonga. — Dry ravines of the Rio Limpio, *Dr. Bigelow.*

* * * Folia coriacea, adulta subtus porulosa-punctata.

4. F. RETICULATA (Torr. l. c.): glabra; foliis ovatis seu ovato-oblongis sæpe acuminatis (1 – 2-pollicaribus) serrulatis utrinque reticulato-venosis supra nitidis basi obtusis vel rotundatis; drupa ovali-globosa breviter pedicellata. — W. Texas, along the Limpio, Pecos, &c., *Wright,* no. 627, 565, *Bigelow, Schott.*

5. F. PORULOSA (Poir.): glabra; foliis oblongo-lanceolatis seu anguste oblongis plerumque obtusis integerrimis (1 – 2-pollic.) basi subpetiolatis, venulis haud conspicuis; drupa ovoideo-oblonga pedicellata. — Myrica segregata, Jacq. Ic. Rar. 3, t. 625. Adelia porulosa, Michx., Fl. 2, p. 224. Borya porulosa, *Willd. Spec.* 4, p. 711. Forestiera porulosa, Poir. Dict. Suppl. 2, p. 664. F. Jacquiniana, *Didrichson in Ind. Sem. Hort. Haun.* 1838, *ex Linnæa,* 27, p. 737. — West Indies? *Jacquin.* Coast of Florida, *Michaux, Dr. Leitner.* Eastern part of Cuba, *Wright,* no. 411.

Var. β. PHILLYREOIDES: foliis ovato-oblongis parvulis (subpollic.) subtus tomento laxo pubescentibus; floribus nonnullis (ut in sp. fere omnibus) hermaphroditis. — Piptolepis phillyreoides, *Benth. Pl. Hartw.,* p. 29. Forestiera phillyreoides, *Torr. in Bot. Mex. Bound. Surv.,* p. 167. Guanaxuato, Mexico, *Hartweg,* no. 259.

Var. γ.? ANGUSTIFOLIA: foliis glabris lineari-spathulatis oblongo-linearibus lanceolatis vel anguste linearibus obtusissimis plerumque aveniis. — F. angustifolia & F. phillyreoides, var. spathulæfolia, *Torr. l. c.* — Lower parts of Texas and Northern Mexico; common. Coll. *Berlandier,* no. 3024. *Lindheimer,* no. . *Wright,* no. 566.

Jacquin's figure, so long overlooked, but recently brought to notice by Didrichson, exactly represents the West Indian plant, as it occurs in Wright's collection (flowering specimens in coll. 1856 – 57, and fine fruiting ones in coll. 1859 – 60); and these accord pretty well with a fragment of the Florida species in Dr. Torrey's herbarium, collected by the late Dr. Leitner. To the same species may safely be referred Bentham's *Piptolepis phillyreoides,* and probably Torrey's *F. angustifolia,* although this is more doubtful, as completely intermediate forms have not been met with. *Piptolepis,* as Dr. Torrey remarks, is identical with *Forestiera,* most, if not all, of the species producing some hermaphrodite blossoms.

Four hundred and seventy-sixth meeting.

February 14, 1860. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from Messrs. Chauncey Wright and Simon Newcomb, of Cambridge, in acknowledgment of the notification of their election as Fellows. Also various letters relative to the exchanges of the Academy.

The Hon. Josiah Quincy addressed the Academy upon the subject of a memorial before the State Legislature, in behalf of the Boston Society of Natural History, and other societies, associated in the petition for a grant of land for practical scientific purposes. The subject of the memorial was also advocated by Professor Rogers and Mr. Emerson ; and Messrs. Parsons, Loring, and Charles Jackson were appointed a committee to further the memorial before the Legislature.

Mr. Treadwell read a communication

On the Strength of Cast-Iron Pillars.

The great calamity which recently fell upon Lawrence having called the attention of the public to the subject of cast-iron columns or pillars, which are now so generally used in all our structures, I have thought that a few words upon this subject may not be without interest to the Academy. It may happen, moreover, that after considering the state of knowledge upon the subject, and the glaring discrepancies and contradictions contained in the practical rules and tables in common use by builders, the Academy may see fit to adopt some action tending to a revision of these guiding rules.

We have no record of any experiments to determine the power of iron to resist a force applied, in any of the four or five ways in which it may be applied, to break it, until about a hundred years ago, although such experiments might have been made and kept as secrets, or passed as traditions in the trade. About a hundred years ago, Musschenbroek made numerous experiments upon the direct tensile or cohesive strength of both wrought and cast iron; and, although the experiments were numerous, the results obtained gave much more strength to iron than later experimenters have been able to obtain. But neither Musschenbroek, nor, as far as I have found, any other experimenter, attempted to determine the power of cast-iron to resist a compressing force, like that to which columns are subjected, until near the commencement of the present century. As early as the year 1757, however, Euler published a paper in the Berlin Memoirs, which seems to be a sequel to some previous work of his upon the subject that I have not seen. This paper consists of an elaborate geometrical investigation of the comparative strength of columns of the same materials, but of different diameters and lengths, without, however, determining the *absolute* strength of any one material, or any one size of column, as this indeed could be done only by experiment. No proper and useful practical rules, applicable to cast-iron or stone, could therefore be drawn from the conclusions arrived at. But the theoretical conclusions of Euler deserve to be noticed, both on account of the great mathematical power of the man, and the somewhat near conformity which his formula bears to the truth, as derived from the latest and best experiments. Euler's results may be summed up in a very few words. They were these: — With columns of the same material and of equal diameters, but of different lengths, the strength must be inversely as the squares of the lengths. If the lengths be equal and the diameters unequal, the strength must be as the fourth powers of the diameters directly. Thus, let A and B be two columns of equal diameters, B being twice as tall as A. A will bear four times the load carried by B. And if C and D be two columns of equal height, D being twice the diameter of C, then D will bear sixteen times the load borne by C, or, in general, $P = \frac{d^4}{l^2}$.

Here the application of science to columns, or at least to cast-iron columns, rested, until some time near the commencement of the present century, before which time, indeed, none were used in this country. Younger men than I can well remember when there was not a cast-iron pillar bearing up a single wall or floor in Boston, though they now constitute the principal support of enormous piles scattered through every street. In England the use of cast-iron commenced somewhat earlier than in this country, as the material was there much cheaper, and the art of founding it practised more perfectly. In both countries, however, it was used with much caution. The engineers best acquainted with it knew its uncertain, not to say treacherous character. They proceeded, therefore, with great caution, taking care to make a great allowance for defective workmanship, and the disturbing influences of change of temperature, movements in foundation walls by the yielding or freezing of the earth, vibrations from moving loads, and the motion of machines, and other influences. By this cautious mode of proceeding they kept within the limits of safety, though sometimes, no doubt, with a prodigal use of iron.

It seems that in the year 1795, Mr. Reynolds, a well-known engineer, made two or three experiments upon the powers of bars, one inch square and three feet long, to sustain weights pressing upon them endwise. But these experiments are not related with sufficient detail to have furnished any useful conclusions.

In the year 1818, Mr. George Rennie published in the Philosophical Transactions an account of his experiments on the power of cast-iron to resist a crushing force. These experiments were confined to small specimens in the form of cubes and prisms. The largest cubes, having sides of one fourth of an inch, being crushed by 12,666 pounds, and the largest prisms, of one fourth of an inch base by one inch in height, being crushed by 6,440 pounds. Experiments like these would form a very insecure foundation for any rule to determine the strength of long columns, however, because such columns are not destroyed by being really crushed, but by being crippled by the compressing force, bending sidewise and breaking transversely.

About two years after the publication of Mr. Rennie's paper, Mr. Tredgold, a man who attained, and that deservedly, a high reputation as a writer upon engineering, endeavored to find from the very scanty materials then existing, by geometrical methods, the absolute strength of cast-iron pillars of all sizes; and to give rules to be used by practical builders, that should be trustworthy for their guidance. Mr.

Tredgold devised a formula, from which tables have been calculated that have gone into general use, and are now in the hand-books used by builders. I have here one of these hand-books, published by Weale of London in 1859, and of which these tables form a part. I shall return to them presently.

The next important step in these investigations, taking the order of time, was made by Mr. Hodgkinson, about the year 1836. Mr. Hodgkinson was even then most advantageously known for his experiments upon iron in the form of girders, or when exposed to cross-fracture. His experiments upon columns or pillars were very numerous, amounting to near three hundred, and were admirably contrived; and on reading his clear account of them, one only regrets that they were not extended to greater instances, and not confined, as they were, to loads of less than twenty-five tons, although, indeed, this is a greater weight than had ever been used before for experiment. In the account of these experiments, we have the weights required to destroy solid pillars of from 60 inches in length down to $7\frac{1}{2}$ inches, having their diameters from half an inch up to two inches. To state a few of his results in a very general way. He found that pillars 60 inches long, half an inch in diameter, were broken by a weight of 143 pounds; 30 inches long, half an inch in diameter, by 539 pounds; 15 inches long, half an inch in diameter, by 1,904 pounds.

These were the breaking weights when both ends of the pillars were rounded so as to bear only upon the centre of the pillar. Now these numbers are to each other as 1, $3\frac{3}{4}$, and $13\frac{1}{3}$. The squares of the lengths, if taken inversely, would be 1, 4, and 16. These ratios were maintained as well when the ends of the pillars were flat, as when they were rounded; but when flat, so as to bear upon every part of the end, the actual power of the pillar to sustain pressure was increased about threefold. Again, with pillars of the same length, viz. 60 inches, but of different diameters, he found, that those with a diameter of half an inch broke with a weight of 143 pounds; those with a diameter of one inch, with 1,902 pounds; those with a diameter of two inches, with 24,291 pounds.

These numbers are to each other as 1, $13\frac{1}{2}$, and 170, while the cubes of the diameters are to each other as 1, 8, and 64; the fourth powers or squares of the squares are as 1, 16, and 256. The ratio, therefore, is much above that of the cubes of the diameters, and below that which Euler had assigned, namely, the squares of the squares or fourth powers.

Mr. Hodgkinson endeavored, by a careful and minute analysis, to obtain fractional exponents that should express, in a single formula, the relations of strength, for both difference of height and diameter, with more exactness than any hitherto proposed; and he arrived, after examining many other powers, at the formula $\frac{d^{3.6}}{l^{1.7}}$, d being the diameter, l the length, as giving the relation of strength for cast-iron pillars of different sizes; and this may be taken with perfect confidence as giving the *utmost* strength within the limits to which experiment has been carried. The above formula merely determines the *comparative* strength of pillars of different sizes and proportions. To obtain the actual strength of any pillar, Mr. Hodgkinson, finding the diameter d, in inches, and the length, l, in feet, and taking, for pillars with round ends, 14.9 for a coefficient, gives $14.9 \frac{d^{3.6}}{l^{1.7}} = W$, the weight in tons that the pillar will just break under; and changing the coefficient 14.9 to 44.7, he obtains the weight that will break pillars with square or flat ends. These coefficients were obtained by him as a mean, from a careful comparison of all his experiments, and appear to be, as I have before said of his exponents, sufficiently near the truth to be relied upon for all iron of good quality. At the same time, I think we ought always to be aware of the caution given by Biot, and "trust no such formula much beyond the light of experiment." While Hodgkinson thus gives a much more exact formula than that of Euler for cast-iron pillars, he retains that of Euler for wooden columns, as preferable to his own.

Besides this course of experiments upon solid pillars, he made a very good series upon those formed hollow. These ranged through diameters from $1\frac{3}{4}$ inches up to $3\frac{1}{2}$ inches, the thickness varying from .28 to .33 inch; the same length, namely, $7\frac{1}{2}$ feet, being taken in all cases. The greatest breaking weight used was 50,477 pounds. These experiments seem to have been as well contrived and executed as those upon solid pillars; and while they show with more exactness than had before been given the vast increase of strength obtained from a given quantity of iron by casting it in the hollow, rather than in the solid form, they did not reach up to sizes large enough to determine beyond a doubt, from this law of increase, a rule which may be perfectly relied upon for hollow pillars of very large size, with very thin walls. He found that his formula, as applied to solid pillars, was applicable to those of a hollow form, by merely changing $d^{3.6}$ into $d^{3.6} - e^{3.6}$, in which d and e are the external and internal diameters, respectively.

Mr. Hodgkinson likewise extended his experiments to some other materials than cast-iron, as wood, wrought-iron, and cast-steel.

Taken altogether, these researches are undoubtedly the most valuable that have been made upon the subject. But after all, Mr. Hodgkinson's paper must be considered in the light he intended it for; namely, as a scientific investigation of the strength of pillars, and not a practical treatise, giving to architects and builders rules that they may follow with confidence in their erections. As the matter now stands, each architect or engineer who would follow this paper must, after finding the limit of strength for any proposed column, determine for himself how far he will keep within this limit, or where safety ends and danger begins. To show how far it is required in practice to carry the strength beyond that assigned by inferences founded upon calculation, to obtain security against all disturbances, and the imperfections of workmanship, I will cite an example or two. A water-pipe 12 inches in diameter, and half an inch thick, ought, from deductions made from the tensile strength of cast-iron, to sustain a column of water more than 3,000 feet high. But where is the engineer that would dare to load a series of such pipes with a column of 300 feet high? Again, a steam-boiler 30 inches in diameter and $\frac{1}{4}$ of an inch thick, ought to hold steam of more than 1,000 pounds' elastic force. But in practice 60 pounds is considered enough for such a boiler. These instances should certainly, in the case of cast-iron pillars, teach us to keep widely within the ultimate, or what may be called the theoretical strength. No practical directions have, as far as I know, been given in any engineering work founded upon Hodgkinson's experiments. The tables by which architects in Boston are governed are derived from the formula of Tredgold, to which I have before alluded. I will finish what I have to say, by comparing a few of the numbers of these tables with each other, and with the experiments and formula of Hodgkinson. I take from these tables a solid pillar 2 inches in diameter, 6 feet long. To this the load assigned is 61 cwt., while 2 inches' diameter 12 feet long is made to carry 32 cwt.; numbers very nearly in the inverse ratio of the height. Hodgkinson gives for the ratio of these lengths 1 to $3\frac{1}{4}$, and Euler 1 to 4.

Again, I take from these tables a pillar

8 inches in diameter, 6 feet long, and the breaking weight is			1,315 cwt.	
8 inches in diameter, 12 feet long,	"	"	"	1,224 "

Or, it loses only about 9 per cent by being of double height. While the ratios assigned by Hodgkinson would be, as before, 1 to $3\frac{1}{4}$, and by Euler 1 to 4.

Again, how do these diameters compare, taking for the same lengths? We have:

12 feet long, 2 inches in diameter, bearing . . .	32 cwt.
12 feet long, 8 inches in diameter, bearing . . .	1,224 "

Or about as 1 to 40. While the formula of Hodgkinson gives the ratios to these diameters as 1 to 147, and Euler's formula 1 to 256.

Next for a comparison of hollow pillars. Hodgkinson found that a hollow pillar $7\frac{1}{2}$ feet long, 3.36 inches in external diameter, and .36 of an inch thick, being on round or hemispherical ends, broke only under a load of 50,477 pounds, or $22\frac{1}{2}$ tons. Now, we have in the tables no length under ten feet. Taking this height and the diameter at $3\frac{1}{2}$ inches, with a thickness of half an inch, and to this is assigned a breaking weight of 3 tons 15 cwt., or 75 cwt. But according to Hodgkinson's formula, carried but a very little way from his actual example, such a pillar will sustain a weight of 18.9 tons or 379 cwt. with round ends, or 56.7 tons or 1,138 cwt. with flat ends. Again, to find from the tables a hollow column 10 feet long that will bear a weight of 18.9 tons, I find that it should be 8 inches in diameter and $\frac{3}{4}$ inch thick, and to bear 56 tons it should be 11 inches in diameter and $1\frac{1}{2}$ inches thick.

We see, therefore, that whatever discrepancies and incongruities these tables may contain, they are all, most probably, within the limits of safety, though the longest and smallest solid pillars are but just within those limits; while certainly the large and short ones are safe to a somewhat prodigal use of iron. But ought these incongruous rules to be followed? Safety, absolute safety, against all ordinary, and some even extraordinary circumstances, should first be provided for; beyond that, weight of iron is almost waste of iron; and it seems to me that it would be a good service to mark out where this line is, under different conditions, and to give rules for keeping safely within it, — rules that shall be consistent with the law of strength for small as well as for large columns.

Whereupon a committee, consisting of Daniel Treadwell of Cambridge, J. B. Francis of Lowell, and J. B. Henck of Boston, was appointed to examine and report upon the whole subject.

Professor G. P. Bond communicated the results of a series of photographic experiments, executed at his request by Mr. Whipple, upon the light of the Sun and Moon, compared with that of the planet Jupiter.

The results tend to support the suggestion that the latter is a self-luminous body. Several analogies were pointed out. The physical constitution of the atmospheres of the Sun and Jupiter, the periods of the solar spots, and the phenomena attending the transits of the satellites of Jupiter, were referred to in the same connection.

Professor Bond stated that a phosphorescent condition of the atmospheres of the larger planets might be anticipated as a consequence of Vaughan's theory of the source of solar heat and light, and that this consideration had first suggested the experiments in question. His object, however, was not at all to advocate the theory, but rather to present a variety of facts, all tending to show a remarkable analogy between the Sun and the largest planet of the system.

Dr. Holmes proposed the term *Reflex Vision* to characterize the visual acts illustrated by the following experiments: —

1. Close one eye, leaving the other open. Hold a finger between the open eye and some small object, so as to conceal this object. Open the other eye, and the object will be seen as if through the finger.

2. Place the hand edgewise between the eyes, so that the eye last opened cannot see the finger. The object will still be seen as if through the finger.

3. Place a wafer on the back of a paper stereograph, so that it can be seen in the instrument by one eye only; for instance, the left. An image of the wafer will be seen in the right side of the stereoscope, which cannot always be distinguished from the wafer itself, except by trying it with the finger, or in some similar way. The left image may be called *direct*, the right, *secondary*.

4. Trace a circle round the secondary image with a lead pencil. Fasten a wafer on the end of a narrow strip of card. Push this wafer into the circle just traced. The two wafers will coincide, and appear as one. Draw the wafer gradually away, and it will carry the secondary image with it, leaving the circle blank. Continue drawing it away, and at a certain distance (about one diameter of the wafer, for instance) the secondary image will separate from the moving wafer, and sail very slowly back into the traced circle.

5. Close one eye and look at a window with the other. Now shut both eyes, and there will be a spectrum of the window in the eye which was opened, and in that only.

6. Repeat the experiment, keeping both eyes open, but in such a position that only one shall see the window. Close both eyes, and there will be a spectrum of the window in both eyes, most distinct, frequently, in the eye to which the window was not visible.

These experiments appear to show that an image formed on one retina produces a retinal spectrum undistinguishable in many cases from a direct retinal image. That the seat of this secondary spectrum is the retina, is shown by the fact that the eye must be opened in order that it shall be perceived. The retina seems to require the stimulus of light in order to repeat the impression. Again, in the sixth experiment, the spectrum in the eye which has not seen the object is like that in the eye which has seen it; and this is always recognized as a retinal spectrum.

If the conclusion from these experiments is correct, the transfer of impressions from one retina to the other falls into the great category of reflected nervous actions, and is properly called *Reflex Vision*. The recognized *connection of the retina by looped fibres*, the decussation of the optic nerves, the connection of the optic ganglia, afford abundant anatomical confirmation of the probability of the suggestions offered.

To state the general result of the experiments briefly: —

If an object, A, is seen by one eye only, both being open, there will be a direct image, a, and a reflex image. a'. The retinal impressions will be represented by $a + a'$.

If A is seen by both eyes, the retinal expression will be $a\ a' + a\ a'$.

If A by one eye, and B by the other, $a\ b' + b\ a'$.

The direct and reflex impressions exactly coincide in the normal state, except so far as ocular parallax makes a difference between them. This want of *precise* coincidence between the superimposed or coinciding direct and reflex images is associated with the idea of solidity, and is reproduced in stereoscopic pictures.

Four hundred and seventy-seventh meeting.

March 6, 1860. — Special Meeting.

The President in the chair.

Mr. E. S. Ritchie exhibited a series of experiments in Magneto-electricity. He gave a brief account of the several steps which had led to the invention of the Ruhmkorff apparatus, and spoke of the effect of the condenser first introduced by Fizeau, which at once converted the instrument into a powerful source of tensional electricity. After alluding to the increased energy which he had been able, by certain modifications, to impart to the apparatus, he proceeded to show its effects by a variety of experiments, exhibiting the spark as transmitted through the air, the charging of the Leyden jar, the illumination of the Torricellian vacuum and of various gases and vapors when greatly rarefied, and the influence of the poles of a powerful magnet on these luminous discharges.

In the course of these experiments he showed the effect of a current of air upon the form of the spark as first observed by Du Moncel; the brilliant explosive spark of the Leyden jar in the outer helix, discovered by Grove; the common and stratified discharges through a tall vacuum-tube containing vapor of turpentine; the same through a tube of uranium glass displaying the characteristic fluorescence; the phenomena of Gassiot's cascade, with the purplish fluorescence of the outer glass and the green of the uranium goblet within; the various-colored light and its stratifications in the rarefied gases of Geissler's Tubes; the strong fluorescence of solution of sulphate of quinine when illuminated by some of these lights; the spectra furnished by others; the attraction and repulsion of a magnetic pole on the luminous strata;

and De la Rive's experiment of the revolution of the luminous streams *in vacuo* around the poles of a magnet.

Professor W. B. Rogers called attention to the nature and extent of the improvements which Mr. Ritchie had made in the Ruhmkorff apparatus.

In the construction used by Ruhmkorff and others, the outer helix is wound in strata or courses parallel to the axis of the coil, separated from one another by layers of insulating material. This brings into proximity parts of the circuit which are really remote from each other as measured along the course of the wire, and by the unequal tension of the electric wave at these points tends to produce discharges within the helix or around its ends.

In instruments having a moderate length of wire, the insulation is sufficient to prevent such discharges; but when the coil is made up of a great number of these superimposed courses, the enormous difference of tension between the outer and inner parts of the helix overcomes the resistance of the insulating material, and either destroys the action of the instrument by an internal discharge, or wastes a great part of its energy by frequent sparks around the extremities. If to obviate these evils we increase the thickness of the insulating sheets, we augment in the same proportion the distance through which the primary coil exerts its inducing power upon the outer helix, and thereby in a still higher ratio impair the energy of the induced current. Thus constructed, therefore, it would appear that the power of the instrument is unavoidably restricted within moderate limits.

It is but just to state, that Professor Poggendorff was the first to point out this defect in the Ruhmkorff apparatus, and to attempt its remedy by dividing the helix into short sections. But he made no further application of the principle than to construct instruments with eight short coils placed end to end, which, although somewhat more effective, were still, as he confessed, too much exposed to "the disturbing effects of internal sparks" to present a very decided advantage.

Mr. Ritchie, abandoning the attempt to improve the apparatus on the old construction, determined on *building up the helix from a series of thin strata or rings placed perpendicular to the axis.* By this arrangement the distance between the points of a stratum increasing with their difference of tension, *the resistance is augmented in proportion to the tendency to discharge*, and thus each stratum is effectually precluded from the production of sparks within itself. It only remains, therefore, to interpose a sufficient insulation between the successive strata to prevent discharges from one to the other, and the instrument becomes secure from the enfeebling or destructive losses incident to the old construction of the coil. Such was the theory of the improvement; and Mr. Ritchie soon devised a contrivance for winding the helix in planes perpendicular to the axis, carrying the wire alternately from the inner to the outer circumference, and from the outer to the inner, and at the same time securing perfect insulation within and between the strata.

The new construction proved eminently successful, conferring on the coil a tension much greater than had hitherto been attained. By further improvements in details, Mr. Ritchie has continued to add to its power, so that now, while the best European coil cannot be relied on for a spark of more than five inches, Mr. Ritchie's first-class instrument projects its luminous flash across an interval of fifteen inches, and exhibits other electrical phenomena on a scale of corresponding magnitude and splendor.

Among the subordinate improvements devised by Mr. Ritchie is a new construction of the breakpiece, in which a spring, bearing the platinum plate and pressing it firmly against the "anvil," secures a closer contact than by the ordinary arrangement. The separation is made by the blow from a spring-hammer worked by a small ratchet-wheel. In this way the *time* of contact is sufficiently prolonged to allow the iron core to be fully magnetized and the electricity to be developed throughout the wire, which, in a helix of thirty miles, must require an appreciable time. This advantage is of course lost in the automatic interruptor of De la Rive, where the armature is so instantly withdrawn as in a moment to break the current. In Mr. Ritchie's plan, moreover, the manipulation of the instrument is placed entirely under the control of the operator, so that by varying the intervals of interruption he can vary the length and character of the spark, and by proper adjustment obtain the greatest length of spark of which the apparatus is capable. To prevent the discharge taking place through the primary coil or its core, Mr. Ritchie, as a substitute for the insulating tube, interposes a bell-glass closed at the top, and with its lower edge turned outward in a flange. He makes the secondary helix in one or several portions, each wound upon a gutta-percha bobbin, so that one or all can be lifted from around the glass bell, which in like manner can be lifted from the primary. The secondary helix of his first-class apparatus contains about thirty miles of wire; that of the apparatus giving a ten-inch spark contains eighteen miles.

Another novel feature in the construction of the instrument, found by Mr. Ritchie materially to augment its power, is *the extension of the primary helix and its core to some distance beyond the ends of the secondary.* In the smaller instruments he adopts the proportion of two to one, and in the larger, of about one and a half to one.

Mr. Ritchie, moreover, separates the condenser into several portions, each connected with a screw upon the base of the instrument, enabling the operator to vary at will the amount of condensing surface, or to dispense with it entirely, and by these changes giving rise to many remarkable varieties in the phenomena.

In addition to these peculiarities contributing to the superiority of the instrument, it should be mentioned that Mr. Ritchie uses a much finer wire in the secondary coil, and a much coarser in the primary, than have heretofore been employed. It should not be omitted in the comparison, that while the European apparatus requires for the full development of its action a large intensity-battery, his coil is excited by *a few cells* to the highest display of its power.

Professor Rogers called attention to the peculiar characters of the spark of the induction coil when transmitted through the air at different distances between the terminals. When the distance is short, as, for example, one or two inches in the instrument exhibited to the Academy, the spark has the peculiar twofold character first noticed by Du Moncel, and since minutely studied by him and Perrot and others; that is to say, it is formed of a slender, brilliant thread, enveloped by a much wider and less luminous space of a somewhat ruddy, flame-like aspect. As the striking distance is increased, this surrounding glow becomes less conspicuous, in comparison with the brilliant thread of light, and at last, when the interval has been sufficiently extended, it nearly or wholly disappears, leaving the spark to consist of a slender, jagged, brilliant line.

These two parts of the luminous discharge, which we may call the *flame-spark* and the *thread-spark*, present remarkable differences of character, indicating very unlike states of tension in the currents or portions of current to which they are severally due. Thus the flame-spark possesses great heating power, while the thread-spark is almost destitute of it; hence the facility with which paper and other combustibles are ignited, when placed in a short spark, and the entire failure of this effect when they are made to intercept a long one.

The fact of the spreading out of the flame-spark under the impulse of a transverse blast of air, while the luminous thread experiences no change, would naturally suggest the comparatively *slow motion* of the former; and accordingly Robinson of Armagh, by applying the test of the revolving mirror, has proved that the velocity of the flame-spark is very much less than that of the thread-spark.

Recently, Du Moncel and Perrot have made numerous experiments on the two kinds of sparks, and the latter, availing himself of the effect of a current of air on the flame-spark, has succeeded in separating the two so completely as to be able to mark more certainly their respective peculiarities. These observations have shown that the current belonging to the flame-spark is endowed with decided magnetic and chemical, as well as heating powers, while that of the other is as little efficient in these respects as that of common frictional electricity. In view of these various characteristics, we are entitled to conclude that the flame-spark is due to a current of low tension, like that of an ordinary voltaic arrangement, and the thread-spark to one of high tension, comparable to the discharge of an electrical machine. Whether these currents are to be regarded as simultaneous or alternating in their transit through the coil, remains to be determined.

The very different character of the discharge through the air when the terminal wires are near each other, and when far apart, is no doubt dependent on the different degrees of resistance which the interposed air presents to the passage of the current. When the terminals are at a short distance asunder, the induced current, having comparatively small resistance to overcome, begins to pass across before its tension has been much exalted, and thus discharges itself continuously during a short time and at a low tension. But when the terminals are widely separated, the current is at first unable to make the transit, and has to accumulate a very high tension at the terminals in order to overcome the greatly increased resistance; and when at length it forces a passage, it does so, as might be expected, with a correspondingly greater velocity, and completes the discharge more nearly in an instant. Thus, in the former case it shows itself chiefly as the flame-spark, in the latter, as the thread-spark.

The remarkable difference of tension according to the distance between the terminals, or, in other words, to the length of the spark, is no doubt one, and perhaps the only, reason for the effects observed in attempting to charge a Leyden jar by the inductive machine. When we connect the outer coating of the jar with one of the terminals, and bring the knob quite near the other, we see the broad flame-sparks passing in quick succession; but only a feeble charge is imparted, however we may prolong the experiment. When, however, the knob is held at a much greater distance from the terminal, a few of the long thread-sparks are sufficient to charge the surface strongly.

The beautiful phenomena of *electrical light in rarefied gases*, as exhibited in the electrical egg and Gassiot's and Geissler's vacuum-tubes, afford many interesting subjects of inquiry. As the color of the light is dependent on the specific nature of the gas, and as this is reduced to an extreme degree of rarefaction, we have a means in some cases of identifying such substances when their quantity is so minute as to defy all other means of detection. With tubes of slender bore, affording, as has been seen, a light of great intensity, we may obtain a brilliant prismatic spectrum, which, as Plücker has shown, is marked in each case by some characteristic peculiarity; and with the same arrangement we are able to trace the chemical changes which the enclosed gas or vapor undergoes while subjected to the electrical action.

Perhaps the most important observations in this connection are those recently made by Gassiot, whose ingenious application of the absorbent power of potassa has enabled him to approximate more nearly to an absolute vacuum than any previous experimenter. In a tube thus prepared, he has found that the gas may be so excessively rarefied as to be unable to transmit the current, at this stage ceasing to be luminous. We may therefore conclude that the old notion of a vacuum being a good conductor, which was founded on the electric illumination of the Torricellian space, is entirely erroneous, and that in all cases conduction is dependent on the presence of some form of ponderable matter.

Adverting to the new evidences which these and other recent experiments afforded of the electrical character of the *Aurora*, Professor Rogers called attention to the action of a magnet on the electric light, and more particularly to its power of arranging the illumination in meridional bands, and impressing upon them a movement of rotation, as exhibited in De la Rive's experiment; and mentioned the ingenious suggestion of Grove, that the height of the aurora above the earth's surface might perhaps be inferred from a knowledge of the degree of rarefaction at which like luminous effects were obtained in the vacuum-tubes.

In connection with the *fluorescent* influence of the light of some of the tubes, he mentioned the fact, that, during the brilliant auroral displays of August and September last, he found that a solution of sulphate of quinine showed its characteristic fluorescence quite distinctly when exposed during the height of the illumination.

In regard to the *stratified* character of the discharge, as exhibited so strikingly in some of the experiments, Professor Rogers remarked that this phenomenon, supposed hitherto to belong exclusively to the current of the induction coil, has recently been produced by Gassiot with machine electricity, and with the *continuous current* of a voltaic battery of very high tension. As to the conditions in which the stratification originates, physicists are as yet undecided. The gradation of the phenomenon in different stages of exhaustion does not seem to have been sufficiently considered, and would naturally suggest an hypothesis which may not be unworthy of attention.

When the experiment is made, while the process of exhaustion is going on, the following stages in the effect may be observed: —

1. While the rarefaction is yet very incomplete, the tube is dark, and no current transmitted.

2. When the exhaustion has advanced to a certain point, the current passes and the tube becomes filled with a colored electrical light, which as yet shows no appearance of stratification.

3. At a still higher stage of rarefaction, the column of light begins to exhibit a multitude of extremely thin closely contiguous strata, discernible with a magnifier before they become apparent to the naked eye.

4. As the rarefaction is pushed still farther, these strata become larger and more distinct, with wider intervals of comparatively obscure space between them.

5. Approaching the extreme limit of exhaustion, a few waves occupy the whole extent of the tube, and finally the light ceases as the current fails to be transmitted.

In view of these facts, may we not believe that, *in every case where* *the current passes, it is accompanied by stratification,* — in other words, by a molecular vibration, or the formation of waves rapidly propagated through the gas or vapor, — and that the increasing rarefaction allows a greater amplitude for the oscillations, and thus gives rise to longer and longer waves?

In referring to the *actinism* of the electric light, Professor Rogers described some experiments which, with the aid of Mr. Ritchie and the distinguished photograper, Mr. Black, he had lately made on the photographic energy of the different colored lights of the Geissler vacuum-tubes. These, he stated, were but preliminary to more extensive observations on the subject, which he hoped, through the same kind aid, to be able to report on hereafter. The most striking results thus far noted are the following: —

1. The faint, bluish light surrounding the negative wire is superior in actinic power to the more brilliant glow of the opposite bulb of the apparatus.

2. The actinism of the rays emerging from the tube is greatly increased by passing them through a solution of sulphate of quinine, so as to impress them with the *fluorescent* character.

3. The time required for a distinct photographic impression was greatly less than by the ordinary daylight. In the case of a narrow tube transmitting a bright purplish flash, a strong picture was made on the collodion plate in less than half a second. This corresponded to one turn of the ratchet-wheel, or twelve successive flashes of light passed through the tube. Allowing each flash to occupy tenfold the time of an electric spark, as measured by Wheatstone, we should have an aggregate of time during which the twelve flashes acted of less than $\frac{1}{100000}$th of a second.

A number of positive impressions on paper, printed from the original collodion surfaces, were exhibited as results of these preliminary experiments.

On motion of Dr. C. T. Jackson, the thanks of the Academy were voted to Mr. Ritchie for his interesting and brilliant exhibition.

Four hundred and seventy-eighth meeting.

March 13, 1860. — Monthly Meeting.

The President in the chair.

The Corresponding Secretary read letters relating to the exchanges of the Academy. He also presented from the author the following paper, viz.: —

Observations on North American and some other Lichenes. By Edward Tuckerman, A. M.

Leptogium dactylinum, Tuckerm. in litt.: thallo subeffuso imbricato tenui fragili fusco-viridi, lobis minusculis adscendentibus rotundatis crenato-incisis margine dactylino-dentatis; apotheciis (mediocribus) vix elevatis planis rufo-fuscis margine integerrimo albido demum disparente. Sporæ ellipsoideæ diam. duplo longiores. (Nyl. Syn. Lich. p. 123.) Rocks, Vermont, *Mr. Frost.* Nearest to small states of *L. tremelloides*, rom which it appears to be quite distinct.

Parmelia chlorochroa, Tuckerm. in litt.: thallo substellato-multifido decumbente coriaceo lævi nudo flavo-virescente (stramineo) laciniis discretis laxe intricatis repetito-dichotomis marginibus recurvis (conniventibus) subtus fuscis (nigrescentibus) fibrillis nigris subpannosis; apotheciis...... *P. congruens*, Herb. Floerk., non Ach. (Kamtschatka, *Tilesius* in herb. Floerk.) On the earth, in sterile spots, on the Upper Missouri, near Fort Clark, and near Cannon-ball River, *Dr. F. V. Hayden.* On sand, Inscription Rock (U. S. Pacif. R. R. Survey), *Dr. Bigelow*, Herb. Torr. At the Black Water of the Platte, and the head of the Platte, Rocky Mountains, *Dr. H. Engelmann.* Near to *P. conspersa*, of which it might be taken for a state, differenced by its peculiar habitat; but unmistakably related also to *P. Camtschadalis*, Ach., which was founded on a specimen from Tilesius. Floerke appears to have been acquainted with the collections of the latter (as see Eschw. Bras. p. 202), but referred his specimen of the present Lichen to another species. The *P. congruens*, Ach. Lichenogr. p. 491, was founded on a specimen collected by Swartz, which the latter says (Lich. Amer. p. 5) inhabits trees in North America, and particularly New England. ("Incolit arbores Americæ borealis. In Nova Anglia observata." Sw. l. c.) Whatever this species may prove to be, — and it is now quite unknown to Lichenists, — it is enough to say that the

Lichen before us differs too much from the character of *P. congruens*, and the figure in Swartz's work, to be referred to it. Our plant has nothing of the look of a tree-lichen, and probably never inhabits trees; and there is little reason to suppose that it occurs in New England.

PHYSCIA, Nyl. — This genus, as limited by Dr. Nylander, includes, beside the sharply defined section of *Parmelia*, of the same name, of Fries, and the nearly akin group of Lichens represented by *P. parietina* (*Physcia*, Koerb. pr. p.), also the more receding, everniiform, subpendulous group (*Everniæ* sp., Fr.) represented here as yet only by *P. flavicans*. So far as this species is concerned, it appears far from difficult to connect it very closely with forms of *P. chrysophthalma*, and so with the genus. I propose here to review briefly all the North American Lichens known, referable to *Physcia;* and especially to consider what is probably the true rank of a number of species described by authors from North American specimens.

The genus, with us, falls into two great sections, separated by color, and also by the spores; and between these two, *P. euploca*, from Texas, appears to stand by itself. The first of these sections is made up of *P. parietina*, and the Lichens related to it, distinguished by the more or less yellow color of the thallus, and the colorless spores, in which the contained fluid matter, or protoplasm, separates finally into two opposite roundish masses, or sporoblasts, connected often by a narrow isthmus (*sporæ polari-dyblastæ*, Koerb. Syst. Lich. Germ. p. 90). From this group, *P. euploca* differs in its glaucous-fuscescent coloration, and simply once-septate spores, which are still colorless. And the large remaining section (*Physcia*, Fr.) is well defined by the glaucous-cinerascent (or at length fuscescent) thallus, and once-septate fuscescent spores.

§ I. *Species flavescentes sporis incoloribus polari-dyblastis.*

1. P. CHRYSOPHTHALMA (L.), DC., *a. Parmelia chrysophthalma*, Auct.; Moug. & Nestl. Cr. Vog. n. 254; Tuckerm. Lich. Exs. n. 80. On trunks and branches of trees, especially near the coast; and also rarely inland. North America, *Jacquin* (Collect. 1, p. 117, t. 4), 1786. *Hoffmann* (Pl. Lich. 2, p. 23, tab. 31, f. 1), 1794. Pennsylvania, *Muhlenberg*. New York, *Torrey*. New England to Annapolis, Maryland; and westward to Illinois, *Mr. Russell*, and Minnesota, *Mr. Lapham*. Thickets and bottoms of the Blanco, Texas, *Mr. Wright*.

Var. *β*. PUBERA, Wallr. Flecht. 2, p. 333; Nyl. Enum. Gen. in Act. Cherb., V. p. 106. *Borrera pubera*, Ach. Lichenogr. p. 502. On smaller branches of trees, Texas, *Mr. Wright.* Monterey, California, *Dr. Gregg.* Delicately downy; the smallest states with the habit of the species, but more slender: the larger ones scarcely distinguishable from the next, which occurs pubescent according to Swartz (Wallr. l. c.) and Fries (Lichenogr. p. 28). Apothecia sparingly radiate-ciliate, or oftener entire.

Var. γ. FLAVICANS, Wallr. l. c.; Eschw. Bras. p. 224. *Parmelia* dein *Borrera*, Ach. *Physcia*, DC.; Nyl. Enum. Gen. l. c. On trees, South Carolina, *Mr. Ravenel.* Elongated, as the last, but smooth; pale yellow above; the branches compressed at the axils, and often channelled: apothecia with a thin, not ciliate, but obsoletely crenulate thalline margin, which at length disappears, when the disk (as in other species) appears to possess a thin, more or less evident proper margin. Louisiana, on trees, fertile, *Dr. Hale.* Wallroth (Naturgesch. der Flecht. 2, pp. 333 – 340) was perhaps the first to connect the above Lichens as forms of one species; but his view embraces plants removed even generically from the present type, and others of doubtful relation to it. Eschweiler follows Wallroth as respects his own Brazilian specimens, and also adopts the general view of the former. The rich collections of Mr. Wright, in Texas, where at least two of the forms occur, sufficiently show that the elongated Southern Lichens are inseparable from *P. chrysophthalma*, except as varieties. *Physcia exilis*, Michx. Fl. Bor. Amer. 2, p. 327 (*Borrera*, Ach.; *Parm. chrysophthalma*, c, Fr. Lichenogr. p. 75; *Physcia flavicans*, var. *exilis*, Nyl. l. c.) from trees in Carolina, (*Bosc, Michaux,*) appears to be a smallish, slender, pallescent condition of the present variety. I have Louisiana specimens (*Dr. Hale*) which entirely resemble a South American Lichen referred to *P. exilis* in Herb. Berol. — *P. chrysophthalma* is perhaps (as suggested by Schærer, Spicil. p. 489, and by Eschweiler, l. c.) only *P. parietina, ascendent*, and at length *elongated*, analogous to the ascendent and elongated states of *P. speciosa;* and further attention may well be given to this point on our sea-coast, where the typical forms of both species grow copiously, and often together.

2. P. PARIETINA (L., Duf.), Nyl., *a*, Auct.; Tuckerm. Synops. Lich. N. E. p. 30, & Lich. Exs. n. 79. On trunks and stones near the sea, and also, more rarely, inland, New England. Bristol, Illinois, *Mr. Russell.*

Var. β. POLYCARPA (Ehrh.), Fr.: microphyllina, suborbicularis, flava; lobis complicatis; apotheciis majusculis aurantiacis confertissimis. *Parm. parietina*, f. Fr. Lichenogr. p. 73, & Lich. Suec. n. 106; Schær. Spicil. p. 477; Koerb. S. L. Germ. p. 91. On trees. Arctic America (the specimens intensely colored, and approaching δ), *Richardson* (Hook. in Frankl. Narr. p. 760). New England, common on apple-trees, a conspicuous Lichen, which has passed here for var. *rutilans*, but differs in no respect from Fries's specimen above cited, except greater size. Ohio, *Lea*. Lake Superior, *Prof. Agassiz*. Wisconsin and Minnesota, *Mr. Lapham*. New Mexico (intensely colored, like δ), *Mr. Fendler*. California (on Live Oak), *Mr. Wright*. The apothecia in this are sometimes fibrillose beneath, as in the next.

Var. γ. LYCHNEA, Schær.: microphyllina, suborbicularis, fulva, lobis planis laciniatis apice palmato-incisis crenatis margine adscendentibus pulverulentis granulosis; apotheciis majusculis aurantiacis. On trees, Cambridge. On trees and stones, Ipswich, *Mr. Oakes*. The specimens on stones are regularly orbicular, substellate, of the common pale-yellow color of *a*, and differing in the narrower, divided lobes, which considerably resemble those of var. *ectanea*, Ach., Schær. (Zw. Exs. n. 57), to which our plant might perhaps well be referred, notwithstanding that the margins are more ascendent, and much more granulate; but the latter passes into states which I cannot well distinguish from the present variety. This development is seen in the higher-colored tree-specimens, in which the erectish, densely-granulate margins of the pulvinate thallus give quite a crustaceous aspect to the Lichen, which resembles, often also in color, the var. *fulva*, Schær. Lich. Helv. n. 383, which is hardly other than a state of his var. *lychnea*, n. 549. A specimen from Bavaria (*Physcia controversa*, Massal., Koerb. Parerg. I. p. 38), which I owe to the kindness of Mr. Von Krempelhüber, is larger and better developed than my specimens of the Swiss Lichen; but the American surpasses even that as a well-marked form of *P. parietina*. The spores of our plant are entirely those of the species; varying in size, but often as large as in any form. The base of the apothecia is often fibrillose. On cedars, Inscription Rock (Pacif. R. R. Survey), *Dr. Bigelow*. Lobes flat, wide, but truncate, and irregularly heaped, the margins scarcely ascendant, and naked in the specimens. On charred wood, New Mexico, *Mr. Fendler*. With much the aspect of at least one of the specimens of Schær. Lich. Helv. n. 382 (*P. candelaris*), which I cannot but refer here; the learned author not distinguishing his var.

lychnea from his var. *candelaris*, at the date of the Spicilegium. Arctic America, *Richardson* (Herb. Hook.); approaching the next.

Var. δ. LACINIOSA, Duf.: microphyllina, suborbicularis, lacero-dissecta, e flava aurantiaca; laciniis planis adscendentibus nudis. *Parm. parietina*, e, Fr. Lichenogr. p. 73. Schær. Spicil. p. 477, & Lich. Helv. n. 381. Koerb. S. L. Germ. p. 91. On trees, New England, very common on the coast, the apothecia smallish and scattered; and extending to Virginia. South Carolina, *Mr. Ravenel.* Alabama, *Mr. Peters.* Texas, *Mr. Wright.*

Var. ε. RAMULOSA, Tuckerm.: microphyllina, e virescente flava; lobis pumilis dispersis laxe decumbentibus semiteretibus dichotomo-ramulosis; apotheciis concoloribus. Report on Lich. U. S. N. Pacif. Expl. Exp. ined. On bushes, Mare Island, California, *Mr. Wright.* The lobes pass in this curious variety into subterete branchlets. Spores as in the species.

Var. ζ. FINMARKICA, Ach.: microphyllina, flavo-aurantiaca; lobis erectis laceris lacunosis complicatis apice demum multifido-ramulosis. *Lecanora candelaria*, var. *Finmarkica*, Ach. Syn. p. 192. *P. parietina*, var. *pygmæa*, Fr. Lichenogr. p. 73; Moug. & Nestl. Cr. Vog. n. 743, d. Rocks, Behring's Straits, *Mr. Wright.* An extreme form, referred to *Borrera*, according to Fries, l. c., by Bory.

3. P. CANDELARIA (Ach.), Nyl. Prodr. Gall. p. 60. *Lecanora*, Ach. Lichenogr. p. 416, *a*; Syn. p. 192, *a*. Moug. & Nestl. Cr. Vog. n. 743, *a*. *Parmelia parietina*, i. *concolor*, Fr. Lichenogr. p. 73; Tuckerm. Synops. Lich. N. E. &c., p. 31. *P. parietina*, ε. *candelaris*, Schær. Spicil. p. 477, & Lich. Helv. n. 382, pr. p. *Candelaria vulgaris*, Massal., Koerb. S. L. G. p. 120. On trees. Arctic America, *Richardson* (Hook. in Frankl. Narr. p. 760). Pennsylvania, Muhl. Catal. New York, *Halsey*. New England. Ohio (infertile), *Dr. Hayden*. Louisiana (infertile), *Dr. Hale*. Thallus spreading irregularly, greenish-yellow; the crowded, minute, dissected squamules powdery at the margin, and often passing into a subgranulose crust; apothecia smallish, of the same color. Spores smaller than those of the preceding species, and the spore-sacs always containing many (20) instead of eight spores, as in that. Distinguishable from the small-lobed varieties of *P. parietina*, but the important character of the Lichen is the microscopical one of polysporous spore-sacs; the value of which, in the system, has probably been over-estimated by those writers who have sought to found a generical distinction upon it.

Var. STELLATA, Nyl.: thallo orbiculari stellato viridi-flavo; laciniis planis ambitu multifidis demum subconnatis; apotheciis saturate flavis rufescentibus margine thallino integro demum plicato subtus radiato-fibrillosis. Sporæ minutæ, ellipsoideæ, incolores, "polari-dyblastæ," plures (c. 20) in thecis. *P. candelaria*, v. *stellata*, Nyl. Enum. Gen. l. c. p. 106. *Parmelia diversicolor*, Ach. Syn. p. 210, pro p. *P.* (*Physcia*) *fibrosa*, Fr. Pl. Homon. p. 284; Lichenogr. p. 75. *P. fibrosa* β. *stellata*, Tuckerm. in Darlingt. Fl. Cestr. p. 440, & Lich. Exs. n. 88. On trees and rocks. Pennsylvania, *Muhlenberg*, 1796 (e Hoffm. D. Fl. 2, p. 159). New England, common. New York, *Dr. Sartwell.* Ohio, *Dr. Hayden.* North Carolina, *Dr. Curtis.* South Carolina, *Mr. Ravenel.* Alabama, *Mr. Peters.* Louisiana, *Dr. Hale.* Texas, *Mr. Wright.* The relation of this Lichen to *Physcia* was pointed out by Fries, l. c.; but its full determination, as a stellate, foliaceous form of the European *Parmelia candelaria*, *a*, of Acharius, was left for the microscope, in the able hands of Dr. Nylander. The presence of fibres on the under side of the thalline exciple is a far less uncommon feature in American Lichens than it is in European.

§ II. *Species thallo glauco-fuscescente; sporis hyalinis uniseptatis.*

4. P. EUPLOCA, Tuckerm.: thallo suborbiculari molliusculo fragili glabro e laciniis tereti-compressis dichotomo-ramosissimis apice furcatis implexis appressis glauco-fuscescentibus subtus albidis nudis; apotheciis sessilibus disco fuscescente demum convexo marginemque crassiusculum subcrenulatum excludente. Sporæ suboctonæ in thecis, parvulæ, oblongæ, incolores, uniseptatæ, diam. 3 – 3½-plo longiores. Tuckerm. Suppl. in Amer. Journ. Sci. 25, p. 424. Rocks on the banks of creeks in the hills of the Blanco, Texas, *Mr. Wright.* An elegant species without near affinity, that I can trace, to any other.

§ III. *Species thallo glaucescente (fuscescente); sporis fuscescentibus uniseptatis.*

5. P. ERINACEA, Ach. Lichenogr. p. 599; Syn. p. 222. On trees, California, *Menzies.* Sea-coast of California, *Dr. Parry* (Herb. Torr.). The entire thalline margin of the apothecia appears to distinguish this Lichen, which, in the thallus, resembles the next species, and also some forms of *P. speciosa.*

6. P. CILIARIS (L.) DC. var. ANGUSTATA, Tuckerm. Synops. p. 32.

Borrera angustata, Bory in Herb. Berol. *B. Boryi*, Willd. in Feé, Ess. p. 96, tab. 2, fig. 23, e Fr. Lichenogr. p. 76. *Physcia solenaria*, Dub. Bot. Gall. II. p. 612, non *Borr. solenaria*, Ach. *P. ciliaris*, v. *solenaria*, Auctt. On the earth and upon rocks. Arctic America (*B. ciliaris*), *Richardson* (Frankl. Narr. p. 761). Newfoundland, Bory in Herb. Berol. Rocky Mountains, fertile, Herb. Hook. Shores of Lake Superior, fertile, *Mr. C. G. Loring, jun.* Shores of Willoughby Lake, Vermont, *Mr. Frost.* Does not appear to differ from a Corsican specimen of *P. solenaria*, Dub., from Von Krempelhüber, which is infertile, but with yellowish "cephalodia"; but the cited name, which was given to a different Lichen by Acharius, is hardly to be preferred to that of Bory. Apothecia similar to those of the species, but smaller; the disk black, with a white bloom; the erect margin torn, or at length radiate-fimbriate; spores (of the species) large, olivaceous-fuscous, obliquely ellipsoid, once-septate, about thrice longer than wide. The Lichen is among our rarest.

7. P. AQUILA (Ach.), Nyl. var. DETONSA: e glauco fuscescens; laciniis elongatis subplanis margine coralloideo-subfimbriatis. *Parmelia detonsa*, Fr. Pl. Homon. p. 284; Tuckerm. Synops. Lich. N. E. p. 32, & Lich. Exs. n. 18. Trees and rocks. Pennsylvania (*P. aquila*), Muhl. Catal. New England to Virginia, common in woods. Ohio, *Mr. Lea.* North Carolina, *Rev. Dr. Curtis.* South Carolina and Georgia, *Mr. Ravenel.* Alabama, *Mr. Beaumont.* Mississippi, *Dr. Veitch.* Louisiana, *Dr. Hale.* Much as extreme forms of our Lichen differ from common European states of the species, it is difficult to separate it, even as a variety. I find no difference in the spores. Mr. Wright collected the same plant in Japan. (U. S. N. Pacif. Expl. Exp.) The species appears to be in intimate relations with *P. ciliaris*, and is also near to narrow states of the next species, with which Dr. Nylander (Prodr. Gall. p. 63) compares the American Lichen.

8. P. PULVERULENTA (Schreb.), Nyl. *Parmelia* (*Physcia*) *pulverulenta*, Fr. Lichenogr. p. 79, *a*, thalli laciniis appressis margine nudis, Fr. l. c. *P. pulverulenta*, *a*, Tuckerm. Synops. p. 32. *Parm. pulverulenta, venusta, & muscigena*, Ach. On trunks and rocks, and on the earth, upon mosses. Pennsylvania, *Muhlenberg.* Arctic America (*P. muscigena*), *Richardson.* New England, common on trunks of Elm, and other trees. New York, passing into narrow states resembling the last, *Dr. Sartwell.* Nebraska, on the earth, a fragment, *Dr. Hayden.*

Var. β. PITYREA, Fr., thalli (magis cinereo-virentis) laciniis adscendentibus subtus fibrillosis margine pulverulentis. Fr. l. c. & Lich. Suec. n. 105. *Lichen*, dein *Parmelia pityrea*, Ach.; Moug. & Nestl. Cr. Vog. n. 352. *P. pulverulenta*, v. *grisea*, Schær. Spicil. p. 446, & Lich. Helv. n. 487. *Lichen leucoleiptes*, Muhl. in Herb. Willd. *P. pulverulenta*, v. *leucoleiptes*, Tuckerm. Synops. Lich. N. E. p. 32, & Lich. Exs. n. 107. On rocks and trees. Pennsylvania, *Muhlenberg*. New England to Virginia, common. Texas, *Mr. Wright*. Mountains of New Mexico, *Mr. Fendler*. Lobes often wider than those of *a*, and rock-specimens of the present contrast strongly with tree-specimens of the former. The present is analogous to, and often much resembles *P. speciosa* β. (*Parm. granulifera*, Ach., in the state with the margins of the lobes raised and powdery), but the two Lichens are distinguishable, and appear to represent different types; this presenting the strongly black-fibrillose underside of *P. pulverulenta*.

9. P. SPECIOSA (Wulf., Fr.): thallo cartilagineo-membranaceo virescenti-glauco subtus molliusculo e lacteo fuscescente; laciniis obtusis multifidis subciliatis; apotheciis subpodicellatis disco rufo-fusco nigricante margine thallino incurvo mox crenato-fimbriato. Sporæ octonæ, majusculæ, fuscescentes, ellipsoideæ, uniseptatæ, diam. 2–3-plo longioris.

Var. *a*. STELLATA: laciniis appressis subelongatis inciso-ramosis pinnatifidis margine adscendentibus epruinosis subtus nisi apice epulverulentis; apotheciis subsessilibus mox nudis. *Lichen speciosus*, Wulf. in Jacq. Coll. III. p. 119, t. 7. *Parmelia*, Ach. Lichenogr. p. 480; Syn. p. 211; Fr. Lichenogr. p. 80, *a*; Moug. & Nestl. Cr. Vog. n. 635; Schær. Spicil. p. 447, & Lich. Helv. n. 357; Tuckerm. Synops. Lich. N. E. p. 33, & Lich. Exs. n. 81; Nyl. Prodr. Gall. l. c. p. 61. On trunks and mossy rocks in woods. Pennsylvania, *Muhlenberg*, 1796 (Hoffm. D. Fl. II. 153). New England to Virginia, common in the mountains, but somewhat rarely fertile; the ascendent margins of the lobes often powdery, or passing, on rocks, at the centre, into a thick powdery crust. Lake Superior, *Prof. Agassiz*. Wisconsin, *Mr. Lapham*. North Carolina, infertile, *Rev. Dr. Curtis*. South Carolina, in the upper country, infertile, *Mr. Ravenel*. Alabama, infertile, *Mr. Beaumont*. Louisiana, *Dr. Hale*.

Var. β. GRANULIFERA: stellata, appressa; laciniis subplanis irregulariter laciniatis dentato-crenatis (subpruinosis) granulis globosis niveis aspersis margine demum adscendentibus subtus glabris e fusco nigricantibus; apotheciis subsessilibus disco subnudo margine thallino crenulato mox pulverulento. Sporæ speciei. *Parmelia granulifera*, Ach. Syn. p. 212. On trunks and rocks. Pennsylvania, fertile, *Muhlenberg*. Frederick County, Maryland, infertile. South Carolina, in the low country, abundantly fertile, *Mr. Ravenel.* Louisiana, fertile, *Dr. Hale.* Texas, fertile, *Mr. Wright.* I have specimens compared by me with one from Muhlenberg (from whom Acharius had the Lichen) in Herb. Willd. It is a Southern form, and occurs, covered with apothecia, on the low islands of the coast of South Carolina, while the typical form prefers the mountains, southward, and is rarely fertile. The original plant of Acharius is distinguished by its flatter, less divided lobules, the margins of which are not raised, powdery, or ciliate. A state of this evidently recedes towards *P. stellaris*, with which species it also agrees in its nearly entire, glaucous-pruinose apothecia. But the Lichen varies into a form (exactly *P. granulifera*, Meissn., from Brazil, in Herb. Kunz.) well represented by the Carolina Lichen, which only differs from the type in its shorter, wider, less discrete, and less divided lobes, with margins somewhat minutely notched and powdery; and in its entirely smooth, and at length nigrescent underside. A similar Lichen, also blackish beneath, occurs in Venezuela (*Mr. Fendler*), in which the raised margins of the lobes and the whole centre of the specimen is densely *isidioid*-efflorescent. And Mr. Wright found specimens, growing with *P. applanata*, on maritime rocks in Japan (U. S. N. Pacif. Expl. Exp.), which are colored similarly to the last, and appear fully to belong here, but are besprinkled with regular and rounded soredia.

Var. γ. HYPOLEUCA, Ach.: stellata, glabra, nuda, appressa; laciniis planis multifidis subtus mollibus subpulverulentis; apotheciis subsessilibus maximis nudis, margine crenato-folioloso. Sporæ speciei. *Parmelia speciosa*, v. *hypoleuca*, Ach. Syn. p. 211. *P. hypoleuca*, Muhl. Catal. p. 105; Tuckerm. Synops. p. 33, & Lich. exs. n. 108. Montag. & V. d. Bosch. Lich. Jav. p. 21. On trunks. Pennsylvania, *Muhlenberg.* New England to Virginia, not common, and abundantly fertile. New York, *Dr. Sartwell.* Ohio (a state with erect lobules), *Dr. Hayden.* Texas, both the state above described, which is only sparsely fibrillose beneath at the margins; and another, inseparable, which is without pulverulence and rather thickly fuscous-fibrillose on the under side; *Mr. Wright.* The largest and handsomest state of the species with us, and always distinguishable by its entirely smooth, scarcely notched, often subconnate lobules, which are more or less powdery-tomentose beneath. The Lichen also recedes towards *P. stellaris*, but approaches it less nearly than a similar state of the last variety. The Java Lichen, for which I am indebted to Dr. Van den Bosch, does not appear to differ from ours.

Var. δ. PODOCARPA: stellata, glabra; laciniis plano-convexis multifidis lobulis simpliciusculis subadscendentibus subtus pulverulento-tomentosis margine villoso-fibrillosis; apotheciis elevato-podicellatis pruinosis margine crenato-lobulato. Sporæ speciei. *Parmelia podocarpa*, Bel. Voy. Ind. Or. II. pag. 122, cit. Montag. & V. d. Bosch. Lich. Jav. p. 21. *P. leucomela*, v. *podocarpa*, Nyl. Enum. Gen. l. c. p. 106. On branches of trees in thick woods, Cuba, *Mr. Wright*. But the Lichen is only an intermediate state between the appressed conditions of the present species, and the immediately following erectish state, into both of which it distinctly passes, both in Cuba and in Louisiana (*Dr. Hale*).

Var. ε. GALACTOPHYLLA, Tuckerm.: adscendens, glabra; lobis abbreviatis superne dilatatis repandis subtus pulverulento-tomentosis margine villoso-fibrillosis; apotheciis oblique subpodicellatis pruinosis margine crenulato-sublobatis. Sporæ speciei. *Parmelia involucrata*, Mey. in Spreng. Syst. Veg. Cur. Post. p. 328, e descr. *P. comosa*, Eschw. Bras. p. 199; Nyl. Enum. Gen. l. c. p. 106. *P. echinata*, Tayl. in Hook. Journ. Bot. 6, p. 166, e Nyl. Lich. Exot. *P. ciliaris*, var. *galactophylla*, Tuckerm. Synops. p. 32. *P. speciosa*, var. *galactophylla*, Ejusd. Lich. Exs. n. 82. *Parmelia galactophylla*, Willd. Herb. On trees, very rare northward, and less fibrillose, when it does not appear to differ from the widest states of *P. leucomela*, var. *latifolia*, Flot. & Mey. (Herb. Kunze. Herb. Berol.), and is sometimes (*P. erinacea*, Hamp. in Herb. Kunze, from Peru) almost undistinguishable from European states of *P. ciliaris*; — but southward becoming common and densely fibrillose, the fibres at length covering every part of the surface, as in the state described by Eschweiler. Maine, infertile, *Mr. Oakes.* Cambridge, Massachusetts, on Red Cedar, infertile, very rare. Hingham, on Red Cedar, infertile, *Mr. Russell.* Pennsylvania, *Muhlenberg*, fertile, 1796 (Hoffm. D. Fl. II. p. 144, where it is cited under *P. ciliaris*, under which species Floerke also placed the Lichen, with a mark of doubt, in his herbarium, Herb. Berol.). Ohio, on Red Cedars, fertile, *Mr. Lea.* Mountains of Virginia, *B. D. Greene, Esq.* North

Carolina, *Rev. Dr. Curtis.* South Carolina, *Mr. Ravenel.* Alabama, *Mr. Peters.* Mississippi, *Dr. Veitch.* Louisiana, *Dr. Hale.* Texas, *Mr. Wright.* At first sub-stellate, and scarcely dilated, when the fertile specimens only differ from the last variety so far as the apothecia are less strikingly pedicellate; and the infertile ones from substellate less canaliculate specimens of the next, in nothing but the elongation which is so characteristic a tendency in the latter: — but the short, dilated, erectish lobes of the fully developed and fertile Lichen, and its peculiarly conspicuous, milk-white under-side (which furnishes a more constant distinction than that indicated by the name adopted by Eschweiler), are sufficiently striking. Cuban specimens of the present variety are often more or less suffused, especially at the tips of the lobes, and the margins of the apothecia, with a (sometimes intense) brick-red color; this occurs equally in the preceding variety, and according to Montagne and Van den Bosch (Lich. Jav. p. 22), who consider it adventitious, was regarded as characteristic of his *P. podocarpa* by Belanger. I observe the same in Cuban specimens of the typical form.

Var. ζ. LEUCOMELA, Eschw.: adscendens, glabra, e substellata mox diffusa, elongata; laciniis attenuatis ciliato-fibrillosis subtus pulverulento-tomentosis; apotheciis subpodicellatis pruinosis margine demum radiato-lobatis. Sporæ speciei. *Lichen leucomelas*, L., Sw. Obs. Bot. tab. 11, f. 3. *Physcia*, Michx. Fl. Bor. Am. 2, p. 326; Dub. Bot. Gall. 2, p. 612; Nyl. Enum. Gen. l. c. p. 106. *Parmelia*, Ach. Meth. p. 256; Fr. Lichenogr. p. 76; Montag. Crypt. Canar. l. c. p. 111. *Borrera*, Ach. Lichenogr. p. 499; & Syn. p. 222. *Parmelia speciosa*, b. Fr. Lichenogr. p. 80; Moug. & Nestl. Crypt. Vog. n. 941. *P. speciosa*, var. *leucomelas*, Eschw. Bras. l. c. p. 198. *Lichen comosus*, Bory, Voy. cit. Ach. On trees, and probably also, as in Cuba, on rocks. Trees, Grandfather Mountain, North Carolina, the specimen belonging to the wider states, *Michaux.* On Red Cedars, infertile, Ohio, *Mr. Lea.* On trees in the mountains of Virginia, *Rev. Dr. Curtis;* and of Carolina, *Mr. Ravenel.* Florida, Herb. *Russell.* Texas, *Dr. Parry.* The Ohio specimens were found growing with those of the last variety, which looks like the fertile state of the same lichen; nor is it possible to distinguish narrow-lobed specimens of that from others of the present variety except by the difference of size, and especially of elongation. Excluding from this the short, wide-lobed South American forms (*P. leucomela*, var. *latifolia*, Mey. & Flot. pr. p.), which, as already remarked, are inseparable from states of the last, we appear to have in the Lichen now under consideration — which passes, without any break in the connection, from the substellate and nearly horizontal form of the middle of Europe (Moug. & Nestl. Cr. Vog. n. 941, with which the Ohio, and most of the other North American specimens accord) to the much elongated, almost filamentous, loosely decumbent states of the tropics (*P. leucomela*, var. *angustifolia*, Mey. & Flot.) — the extremest atypical development of our species in a centrifugal direction, as, in the nearly erect variety *galactophylla*, in a centripetal. Professor Fries first observed that this species passed into several varieties ("vario modo mutatur," Lichenogr. l. c.) in America; and did not hesitate also to refer here the *P. leucomela* of Middle and Western Europe, though he retained, as specifically distinct, the narrower, subtropical form. And I owe to him the suggestion that *P. comosa*, Eschw., should be placed here, rather than under *P. ciliaris*. But this last-named species appears itself almost too near to states of *P. speciosa* already cited; — differing, however, to a degree in color, and receding rather towards *P. aquila*.

10. P. Leana, Tuckerm. in litt. *Parmelia* (*Physcia*) *Leana*, Tuck. in Lea, Catal. Pl. Cincinn. p. 45. On trees. Ohio, *Mr. Lea*. Thallus thin and brittle, naked and smooth on both sides; the somewhat ascendent, loosely imbricated lobes multifid, much as in common states of the last species, with flat, nearly entire lobules, which are glaucous-fuscescent above (reminding in this respect of pale states of *P. obscura*) and pale beneath, where occur a few scattered fibres at the margins of the same color. The apothecia are smallish (compared with those of the last species), subsessile, and entire. The spores are smaller, narrower, and more acute. The Lichen appears to partake at once of the characters of *P. speciosa* and *P. obscura*, but I cannot refer it to either. Rocks and trees, Burlington, Vermont, with marginate soredia, *Mr. Russell;* who compares the Lichen with *P. speciosa;* to which Professor Fries considered the Ohio Lichen as approaching nearest. Rocks in the White Mountains, *Mr. Oakes;* similar to the last. Trees, Texas, *Mr. Wright*, a smaller-lobed state, like the last two, growing with *P. obscura;* which is distinguishable at once, by its black and densely black-fibrillose under-side. These latter states, which generally agree with the described plant, appear to approach *P. obscura*, much as that does *P. speciosa*.

11. P. STELLARIS (L.): thallo subcartilagineo glaucescente epruinoso subtus glabro e pallido nigricante fibrilloso; laciniis multifidis; apotheciis sessilibus, margine tumidulo subintegro, disco fusco-atro subpruinoso. Fr. Lichenogr. p. 82, paucis mutatis. Sporæ octonæ, ellipsoideæ, fuscescentes, uniseptatæ.

Var. *a*. AIPOLIA, Schær.: stellata, nuda, glabra; laciniis convexiusculis subtus pallidis. *Lichen stellaris*, L. pro parte. *Parmelia*, Ach.; Fr. Lichenogr. l. c., *a*; Moug. & Nestl. Cr. Vog. n. 163; Schær. Spicil. p. 438, & Lich. Helv. n. 350, 351; Tuckerm. Synops. Lich. N. E. p. 33, & Lich. exs. n. 83; Nyl. Prodr. Gall. p. 61. On trees, dead wood, and rocks. Pennsylvania, *Muhlenberg*. New York, *Torrey*. Arctic America, *Richardson*. New England, exceedingly common, in forms with the lobes subconnate (*P. aipolia*, Ach.), and more distinct (*P. aipolia*, v. *anthelina*, Ach.), and a slender rock-form diverging yet farther (*P. phæa*, Tuckerm. in Darlingt. Fl. Cestr. p. 440) and continuing common southward to Virginia. North Carolina, *Rev. Dr. Curtis*. South Carolina, *Mr. Ravenel*. Alabama, *Mr. Peters*. Louisiana, *Dr. Hale*. Texas, *Mr. Wright*. New Mexico, *Mr. Fendler*. All the specimens from Carolina southward show a tendency to pass into smaller, narrower states, which appear to be inseparable, specifically, from the next.

Var. *β*. ASTROIDEA: stellata, nuda, glabra, microphylla; laciniis planis mox sorediatis subtus e pallido demum nigris. *P. astroidea*, Clem. Ens. Add. p. 302, cit. Ach.; Fr. Lichenogr. p. 81; Tuckerm. Enum. Lich. N. Amer. p. 50; Nyl. Prodr. Gall. p. 62. *P. Caricæ*, Clem. l. c. *Lecanora*, Ach. Syn. p. 188. *P. Clementiana*, Ach. Lichenogr. p. 483; Syn. p. 201; Moug. & Nestl. Cr. Vog. n. 737. *P. Clementi*, Turn. in Linn. Trans. IX. p. 140, tab. 13, fig. 1. *P. sideralis*, Ach. Syn. p. 207. *P. obsessa*, Ach. Syn. p. 213; Montag. Cuba, p. 227. *P. astroidea*, var. *obsessa*, Nyl. Lich. Exot. l. c. p. 255. On trees, New England to Virginia, becoming more common southward. Pennsylvania (*Parm. obsessa*), *Muhlenberg*. North Carolina, *Rev. Dr. Curtis*. South Carolina, *Mr. Ravenel*. Alabama, *Mr. Peters*. Louisiana, *Dr. Hale*. Texas, *Mr. Wright;* who has also collected the same plant in the Loo Choo Islands (U. S. N. Pacif. Expl. Exp.) and in Japan; the latter only differing from the type in its rounded soredia; also in Cuba and Nicaragua. The North American Lichen referred here occurs in forms which I cannot distinguish from normal Portuguese specimens of *P. astroidea*, and in others which pass imperceptibly into *P. stellaris.* These conclusions are results of much, oft-repeated study of large collections of specimens, in numerous states of development and degeneration. The smooth, normal Lichen, as it occurs in Texas and Cuba, may be referred, with equal right, to *P. astroidea* or *P. stellaris.* And the more northern, sorediate form (*P. obsessa*, Ach.) only differs from sorediate European states in the greater size and regularity both of the thallus and the soredia. But in tropical America, our plant departs much farther from its type, acquiring not merely a greater smoothness and elegance, but becoming entirely black beneath (*P. obsessa*, Montag. Cuba, l. c.), a condition which now resembles, in general habit, the present variety; is now larger, on rocks, with the aspect of *P. stellaris;* and finally, occurs on trees, with all the characters, except the color of the under side, of *P. Domingensis*, Montag. Acharius describes his *P. obsessa* as black beneath, while I have always found the northern form, here referred to his species, pale on the under side; but there is no reliance to be placed upon this character in the specimens from Cuba and Nicaragua, which occur, entirely similar above, but now black and now pale-fuscous beneath, and varying in the same manner in the color of the little ring of fibres which often surrounds the base of the thalline exciple.

Var. γ. Domingensis: stellata, nuda, platyphylla; laciniis planis margine sæpius pulverulentis subtus pallidis. *Parmelia* (*Physcia*) *Domingensis*, Montag. Cuba, p. 225; Nyl. Enum. Gen. l. c. p. 106. On trees. Seaboard of South Carolina, *Mr. Ravenel.* Key West, Florida, *Dr. Blodgett.* Louisiana, *Dr. Hale.* Bottoms of the Blanco, Texas, *Mr. Wright.* Passes into the last variety, in Cuba; and an entirely smooth state, from the Bonin Islands, near Japan (U. S. N. Pacif. Expl. Exp. Mr. Wright), exhibits at once the larger and wider lobes of the present, and the smaller and more divided ones of var. *astroidea.* But the American Lichen is almost always and elegantly characterized by its powdery margins. The plant also approaches *P. speciosa*, var. *granulifera* (*P. granulifera*, Ach. Syn.), especially that state with powdery margins (*P. granulifera*, Meissn. in Hb. Kunz.), but is always, so far as my specimens go, distinguishable from that, by a certain divergence of habit, resulting in part from a different lobation; the wider and always flat divisions of *P. Domingensis*, Montag., with their regular palmate summits and slightly notched lobules, contrasting with the more irregular laciniation, and the rather convex and strongly toothed lobes, of *P. granulifera;* which, in the state here referred to, may be *P. Domingensis*, Ach.; a distinct Lichen, according to Dr. Nylander (l. c.) from that so named by Montagne.

Var. δ. (TRIBACIA) Fr.: subadscendens, microphylla; laciniis planis margine eroso-granulosis in crustam dein granulosam conglobatis. *Parmelia stellaris*, c., Fr. Lichenogr. p. 83; Tuckerm. Synops. Lich. N. E. p. 34, & Lich. exs. n. 85. *Lecanora tribacia*, Ach. Syn. p. 191, pr. p. On trees, very common, from New England to Virginia. South Carolina, *Mr. Ravenel.* Louisiana, *Dr. Hale.*

Var. ε. HISPIDA, Fr.: adscendens; laciniis subabbreviatis hispido-fibrillosis apice tubuloso-inflatis. *Lichen hispidus*, Auct. e Fr. *Lobaria*, Hoffm. D. Fl. 2, p. 151. *Parmelia stellaris*, b. *hispida*, Fr. Lichenogr. p. 82; Tuckerm. Synops. Lich. N. E. p. 34, & Lich. Exs. n. 84. *Lichen tenellus*, Scop. Carn. p. 1406. *Parmelia, dein Borrera*, Ach. Syn. p. 221; Moug. & Nestl. Cr. Vog. n. 450. *Physcia*, DC. Fl. Fr. 2, p. 396. *Parm. stellaris*, v. *tenella*, Schær. Spicil. p. 439, & Lich. Helv. n. 352, 562. Trees and rocks. Arctic America, *Richardson* (Hook. in Frankl. Narr. App. p. 761). New England, not uncommon. Analogous to *P. speciosa*, ε. *galactophylla* (*P. comosa*, Eschw.).

12. P. CÆSIA (Hoffm.), Nyl. Prodr. Gall. p. 62. *Parmelia*, Ach. Lichenog. p. 479; Syn. p. 216; Fr. Lichenogr. p. 83. *P. pulchella*, Schær. Spicil. p. 437.

Var. α. (STELLATA) Fr., Tuckerm. Lich. Amer. Exs. n. 86. On stones and dead wood. Pennsylvania, *Muhlenberg.* New York, *Halsey.* New England, not very uncommon.

Var. β. TRIBACIA, Fr.: subadscendens, microphylla; laciniis convexiusculis margine demum eroso-granulosis conglobatis. *Parmelia cæsia*, c, Fr. Lichenogr. p. 84. *Lecanora tribacia*, Ach. Syn. p. 191, pro p. *Parmelia*, Sommerf. Lapp. p. 109. On rocks, New England; very like *P. stellaris*, δ, but differing in the convexity of its somewhat pinnatifid, ash-colored lobules.

Var. γ. TENELLA, Fr.: adscendens; laciniis hispido-fibrillosis. *P. cæsia*, b. *tenella*, Fr. Lichenogr. p. 84. *Parmelia leptalea*, Ach. Meth. p. 198. *Physcia*, DC. Fl. Fr. 2, p. 395. *Borrera tenella*, β. *leptalea*, Ach. Lichenogr. p. 498; Syn. p. 221. On rocks and dead wood. New England? Differs but little from *P. stellaris*, ε, but the same form has indubitably been traced back (Fr. l. c.) to both species. *P. cæsia* is a northern Lichen, near to the last species, but occurring here in the same distinctness as in Europe; nor have I observed any intermediate states. It is, however, by no means as common with us as the last. There are some respects in which one might consider it as bearing possibly the same relation to *P. stellaris* that *P. ciliaris* bears to *P. speciosa* sensu latiori.

13. P. APPLANATA (Fée), Nyl. Enum. Gen. l. c. p. 107. *Parmelia applanata*, Fée Ess. p. 126, tab. 32, fig. 2, & Suppl. p. 123, tab. 42, n. 18; Montag. Cuba, p. 223, tab. 8, fig. 1. *P. plumosa*, Tayl. in Hook. Lond. Journ. Bot. 6, p. 173, e descr. On trees. Seaboard of South Carolina, *Mr. Ravenel;* of Florida, Herb. Gray; and of Alabama, Herb. Sartwell. Louisiana, *Dr. Hale.* Texas, in the valleys of the Blanco, and the Rio Grande, *Mr. Wright.* Thallus thickish, softish, stuppeous-membranaceous, closely agglutinate-appressed, from greenish at length white-glaucescent; beneath scarcely fibrillose, becoming black; lobes confluent, crustaceous-concrete at the centre, radiant and somewhat pinnate-plicate at the circumference; besprinkled at length with rounded soredia; apothecia scattered, a thin, entire thalline margin bordering an at length convex, violet, naked disk, which becomes black, and rests on a black hypothecium. Spores narrow-ellipsoid, scarcely a little curved, fuscescent, the length about thrice exceeding the width. I possess the same Lichen, a strongly marked and distinct type, but connected with Northern types through the next, from many parts of the warmer regions of the earth, and also from Japan (U. S. N. Pacif. Expl. Exp.), *Mr. Wright.*

14. P. OBSCURA (Ehrh.), Nyl. *Lichen obscurus*, Ehrh. Pl. Cr. dec. 18, n. 177, cit. Ach. *Parmelia* (*Physcia*), Fr. Lichenogr. p. 84; Schær. Spicil. p. 441, & Lich. Helv. n. 353 – 4 – 5. *Physcia*, Nyl. Prodr. Gall. p. 63, & Lich. Par. n. 34. *Parm. cycloselis, chloantha, & ulothrix,* Ach. Syn.

Var. *a.* CILIATA: adpressa, substellata, livido-fuscescens; lobis planis linearibus subdigitato-multifidis subciliatis subtus nigrescentibus nigro-fibrillosis (pannosis); apotheciis subtus fibrillosis. *Lichen obscurus*, Ehrh. l. c. *L. ciliatus*, Hoffm. Enum. Lich. p. 69, tab. 14, fig. 1. *Lobaria*, Hoffm. D. Fl. 2, p. 155. *Lichen ulothrix*, Ach. Prodr. p. 113. *Parmelia*, Ach. Meth. p. 200; Lichenogr. p. 481; Syn. p. 217. *P. obscura, β. ulothrix*, Fr. Lichenogr. p. 85. Tuckerm. Synops. p. 34, & Lich. Exs. n. 87. *P. obscura*, var. *ciliata*, Schær. Spicil. p. 442. On trees, dead wood, and rocks. Pennsylvania, *Muhlenberg*. Arctic America (*P. cycloselis*), *Richardson* (Hook. in Frankl. Narr. p. 761). New York, *Halsey*. New England to Virginia, common. Ohio, *Mr. Lea*. Wisconsin, *Mr. Lapham*. North Carolina, *Rev. Dr. Curtis*. South Carolina, *Mr. Ravenel*. Mississippi, *Dr. Veitch*. Louisiana, *Dr. Hale*. Texas, *Mr. Wright*. Very variable. *P. ulothrix*, Ach. is perhaps the most perfect condition of the Lichen, which hardly occurs here without more or less ciliate apothecia, while the ciliation of the lobes appears to be unreliable as a distinction. The present variety includes all our most perfect states of the species, and I have equally fine specimens of the same variety, from Sweden (*Mr. Torssell*), and the finest possible, in all respects, from Japan (U. S. N. Pacif. Expl. Exp.), *Mr. Wright*: but in the South of Europe the Lichen appears to degenerate, and Schærer distinguishes (Spicil. l. c.) the present from *P. cycloselis*, Ach., "omnium partium minutie." I have collected in New England and New York a large, glaucescent state of this (as I confidently consider it), with proportionately wider lobes, densely pannose-fibrillose beneath, and the black, tomentose hairs showing also at the margins, — which may well be *Parmelia setosa*, Ach. Syn. p. 203. There is also, in our mountains, a greenish-glaucous state, with largish, bright-chestnut apothecia (commonly ciliate at the base) which might be passed by for *Parmelia tiliacea*. The following varieties are still more remarkable.

Var. β. ERYTHROCARDIA: strato medullari aurantiaco-rubro. *Parmelia stuppea*, Tayl. in Hook. Lond. Journ. Bot. 6, p. 175. *P. endococcina*, Koerb. Parerg. Lich. 1, p. 36, e descr. On trees. California, *Beechey*, Herb. Hook. (Taylor, l. c.). New England, common, and with the lobes and apothecia of the type. Mountains of Georgia, *Mr. Ravenel*; less ciliate, and the apothecia scarcely so. Does not appear to differ from the type, except in the internal color. Dr. Koerber's Lichen, from the Tyrol, can scarcely differ from ours.

Var. γ. ADGLUTINATA, Schær.: arcte adnata, membranacea, glauco-fuscescens; lobis demum confluentibus margine plicatis apicibus nigrescentibus subtus pallidis. *Parmelia adglutinata*, Floerk. D. L. 4, p. 7; Moug. & Nestl. Cr. Vog. n. 543. *P. obscura*, v. *adglutinata*, Schær. Spicil. p. 442; Nyl. (sub *Physcia*) Prodr. Gall. p. 63; Lich. Par. n. 33. On trees (Hickory, Red Cedar, &c.), Massachusetts. Pennsylvania, *Dr. Michener*. North Carolina, *Rev. Dr. Curtis*. South Carolina, *Mr. Ravenel*. Louisiana, *Dr. Hale*. Texas, *Mr. Wright*.

Appears to be inseparable from the species, and equally so from the European variety (the Louisiana specimens being quite as depauperate as most of my foreign ones), but generally a finer plant than the latter, and when perfect, scarcely differing from states of *P. applanata*, except in color, and in the colorless hypothecium. *Parmelia viridis*, Montag. Crypt. Guyan., & Syll. p. 329, (*Parm. picta*, Montag. Cuba, p. 221, tab. 9, fig. 3, non Ach.), appears to be scarcely separable from the North American Lichen; and these varying conditions are perhaps comparable with the American forms of the European *P. astroidea.*

Pyxine Meissneri, Tuckerm. in litt.: thallo orbiculari cartilagineo radiatim laciniato glabro glaucescente intus sulphureo; laciniis subplanis appressis pinnatifidis imbricatis subtus nigris ambitu fibrillosis; apotheciis primitus thallo concoloribus excipulo thallino subintegro tumidulo discum planum nigrum cingente mox superne nigricantibus margine demum tenuescente nitido disco convexo subexcluso. Sporæ suboctonæ, oblongo-ellipsoideæ, uni-septatæ, mox fuscescentes, diam. plusquam 3-plo longiores. On trees in Cuba, and also in Nicaragua, *Mr. Wright.* And I possess a fine Brazilian specimen, referred to *Physcia* by Dr. Meissner of Halle, from my kind friend, the late Professor Kunze of Leipzig. Thallus differing from that of the next species in its entire smoothness, and its light-yellow medullary layer. The apothecia are at first exceedingly like those of *Physcia applanata*, but the exciple soon blackens above, and presents finally a convex disk enclosed by a shining margin of the same color, thinner than the original thalline border, and often looking, but not really, distinct from it. Professor Fries, in establishing this genus (Pl. Homon. p. 266), indicated its relations to *Umbilicaria*, but did not regard either as Parmeliaceous. In venturing, some years since, to take this view with respect to *Pyxine* (Synops. Lich. N. E. p. 24, and 35) the writer had before him only the more northern Lichen (*Pyxine sorediata*, Fr.), the "at first closed, palish" apothecia of which, "becoming patellæform, and, with the altered thalline margin, black," he considered as indicating "a modification of *Parmelia*, near to" the section "*Amphiloma*, Fr."; a conclusion which the foliaceous thallus, with its compact, crust-like centre, and often dense hypothallus, served to strengthen. But the present species is as clearly inseparable from *Parmelia*, in the sense of Fries, as it is from *Pyxine;* and its position as respects the new tribe *Parmeliei*, as acutely limited, in the light of our present knowledge of the spores and spermogones, by Dr. Nylander, may still perhaps be regarded as between *Physcia* (*Parmelia* § *Physcia*, Fr.) and *Pannaria* (*Parmelia* § *Amphiloma* and *Psoroma*, Fr.): and Eschweiler, it is observable, places his *Lecidea albo-virens* (Lich. Bras. in Mart. Fl. Bras. 1, p. 256), which is clearly *Pyxine sorediata*, as first observed by Montagne (Pl. Cell. Cub. in Sagra's Hist. Cub. p. 188), in the near neighborhood of his *Lecidea* (now *Pannaria*) *microphylla*, in which, moreover, he only followed Acharius. There are several points in Dr. Montagne's description and illustration of his *P. sorediata* (Cuba, l. c. p. 188), and especially his figure *b*, seemingly indicating our present species, which is finally very like smoothish states of the next, and may well occur without any trace of its originally Physciaceous fructification; in which case it should hardly be separable from *P. Cocoes* (*P. sorediata*, Fr.), unless by the color of its medullary layer, to be considered farther on. And thus the remarkable development of the apothecia of *P. Meissneri* might be taken as of value rather as enabling us to determine the true structure and natural position of the genus, than as a specific distinction; but, however the final state of the new species may approach the old, I have examined many hundreds of specimens of the latter, in its best condition (*P. Cocoes β. sorediata*), without finding the least trace or indication of the originally Lecanorine fructification of the former. Spores of *P. Meissneri*, linear-oblong, and more than thrice as long as wide, at first colorless and simple, an elongated sporoblast occupying the centre, but soon becoming fuscescent, and the sporoblast separating into two roundish ones, which are connected by a narrow isthmus, remaining at least until the central dissepiment appears: these sporoblasts finally increasing in size till they meet the walls of the spore, when the well-marked limit of each, and the empty ends of the spore beyond it look like other dissepiments and sporoblasts, and the spore might be called 3-septate (comp. Montag. Cuba, l. c., but the description, as I understand it, is not illustrated by the figure given; and also Eschweiler, l. c., p. 246), which I think it is not.

Pyxine Cocoes (Sw.), Nyl. Enum. Gen. l. c. p. 108. *Lichen Cocoes*, Sw. in Ach. Prodr. p. 106. *Lecidea*, Ach. Meth. p. 84; Lichenogr. p. 216; Syn. p. 54. On Cocoa Palms in Jamaica, *Swartz* (ex Ach.); and in Cuba, *Mr. Wright*. Also in Nicaragua, *Mr. Wright* (U. S. N. Pacif. Expl. Exp.). Acharius distinguished this from his

Lecidea sorediata, mainly by the lighter color and thinner texture of its smoother lobes, and their smoothish under-side; and Mr. Wright's Cuban collections appear fully to confirm Dr. Nylander's opinion (Lich. Exot. in Ann. Sci. 4, 11, p. 239), that neither of these differences, nor that of size, which extends even to the spores, is sufficient to separate specifically the tropical form from the more northern one. The present, so far as my specimens go, appears to be a smaller and less imbricated Lichen than *P. Meissneri*, from which it also differs in its white medullary layer, and especially in its apothecia, which are exactly those of the genus, as described by Fries, and, more at large, by Eschweiler. There is also in *P. Cocoes* a tendency to sorediate efflorescence, which becomes marked and characteristical in the northern Lichen, which, I cannot but think, deserves still a separate, if a subordinate place.

Var. β. SOREDIATA: thallo cartilagineo glauco-cinerascente intus fusco-sulphureo (pallescente), laciniis rugoso-plicatis; sorediis rotundatis cæsiis marginalibus exasperatis subtus subspongioso-fibrillosis; apotheciis cæsio-pruinosis (nudis). *Lecidea sorediata,* Ach. Syn. p. 54. *Pyxine,* Fr. Pl. Homon. p. 267. *Lecidea* (§ *Pyxine*), Eschw. Bras. l. c. p. 245. *Parmelia* (§ *Pyxine*), Tuckerm. Synops. Lich. N. E. p. 35, & Lich. Exs. n. 19. *Lecidea albo-virens,* Eschw. Bras. l. c. p. 256. On trees and rocks, Pennsylvania, *Muhlenberg* (Ach. Syn. l. c. 1814). New England to Virginia, not rare, especially on mountains. Westward to the Rocky Mountains, Herb. Hook. North Carolina, *Rev. Dr. Curtis.* South Carolina and Georgia, *Mr. Ravenel.* Alabama, *Mr. Peters.* Mississippi, *Dr. Veitch.* Louisiana, *Dr. Hale.* Texas, where occur also small forms like *α*, *Mr. Wright.* The same unwearied botanist has collected the Lichen also in Cuba, and in Japan. And I am indebted to Dr. Hooker for an infertile, but otherwise undistinguishable specimen from the Himalaya, and to Dr. Van den Bosch for satisfactory ones from Java. It was upon this Lichen, first observed by Muhlenberg, that Fries constituted his genus. The plant differs from the earlier *P. Cocoes* (Sw.), Nyl., in being every way larger; in its darker, finally ashy color; its regular soredia; and densely spongy-fibrillose under-side: but approaches *P. Meissneri* (to which *P. sorediata,* Montag., Cuba, l. c., should perhaps be referred, in part at least) in its dark-yellow (sometimes fuscous, and often pallescent) medullary layer; which is observable (as indicated by Eschweiler in his *Lecidea albo-virens*), if nowhere else, immediately beneath the hypothecium. *P. sorediata*, var. *endochrysa*, M. & V. d. Bosch, in Montag. Syll. p. 345, "thalli strato medullari fulvescente (chamois)," described from specimens of Junghuhn, is an indication of the last-mentioned feature, which appears to me to show itself (though doubtless finally disappearing, and unknown in *a*) with more or less distinctness, in most of my specimens. In *P. coccinea*, M. & V. d. Bosch, Lich. Jav. p. 40, the same layer is described as blood-red. As already remarked under our first species, the present differs from that in possessing the pseudo-Lecideine apothecia of the genus, as defined by its illustrious author, and others; only varying from their descriptions in the fructification, being at first pale (as indicated by the present writer, l. c.) and also, in the variety now before us, bespread at length with a gray bloom (comp. Eschweiler's "apothecia . . vix canescentia" in his *Lecidea albo-virens*, l. c.), which is very often wanting. The spores of the present form do not differ appreciably from those of other species, unless in proportional dimensions. They are often ellipsoid, slightly constricted at the middle, once-septate, and fuscous; about two and a half times longer than wide: but occur perhaps more commonly in a rather elongated, oblong, less colored and less simple state, in which the protoplasm develops at first (as in many spores) into a square, or oblong sporoblast, which then divides into two, which are connected by a narrow isthmus (like the neck of an hour-glass, or, more often, of dumb-bells) through the middle of which passes the dissepiment of the spore; which reaches, in this state, to nearly the length of the spores of *P. Meissneri*. The ends of the sporoblasts towards the (empty) tips of the spore are so well defined that it is difficult not to describe these sporoblasts as becoming at length larger, oval, and once-septate, and the spore as thus thrice-septate (and this view has been taken by eminent writers), but I venture to propose the above as perhaps the true one; and to regard the genus as possessing spores typically once-septate; and as approaching, therefore, species of *Physcia* as closely in this respect, as it does also, according to Dr. Nylander (in his observations on *P. Meissneri*, in Lich. Exot. l. c., p. 255) in its spermogones.

Pyxine retirugella, Nyl. Lich. Exot. l. c., p. 240, is the only remaining species known, not above noticed. In this, which was collected in Nukahwà, growing on stones and rocks, by Mr. Jardin, the thallus is described as reticulate-rugulose, like that of *Parmelia saxatilis;* and the apothecia as resembling those of the last species. Very elegant specimens, collected by Mr. Wright, from stems of *Pandanus*, in the Bonin Islands (Herb. U. S. N. Pacif. Expl. Exp.), with linear, elongated, *discrete* lobes, which are brought into relief by the black hypothallus, have just the marking above described, and the regular soredia, and whole asyect of *Pyxine;* but are without fructification.

Pannaria leucosticta, Tuckerm. in litt.: thallo e squamulis cartilagineo-membranaceis glauco-fuscescentibus ambitu expansis subelongatis pinnato-incisis centro adscendentibus imbricatis dissectis dentato-crenatis, crenis albo-pulverulentis, hypothallo cæruleo-nigro marginante; apotheciis appressis convexis rufis margine thallino persistente subincurvo crenulato mox pulverulento. Sporæ ovoideæ, simplices, incolores, diam. $1\frac{1}{2}$ – 2-plo longiores. — *Parmelia* (*Psoroma*) *leucosticta*, Tuckerm. in Darlingt. Fl. Cest. p. 441. On trees and rocks. New England to Virginia, not uncommon. Pennsylvania, *Dr. Michener.* North Carolina, *Rev. Dr. Curtis.* South Carolina and Georgia, *Mr. Ravenel.* Alabama, *Mr. Beaumont.* Louisiana, *Dr. Hale.* Approaching *P. microphylla*, from which it differs in the colors, in its larger, dissected thallus, and also in the apothecia and spores. And it also approaches (but is always, so far as I have observed, distinguishable from) subsquamulose states of *P. rubiginosa*. *P. craspedia*, Koerb. Parerg. 1, p. 45 (1859) from Istria, appears to have some (possibly unessential) features of agreement with our Lichen. But it is interesting, in this connection, that one or two other Lichens, first observed in North America, as *Cetraria Oakesiana* (*C. Bavarica*, Krempelh., and now published also, though I know not from what locality, in Massalongo's Italian Herbarium Exsicc.), and possibly *Physcia obscura*, var. *erythrocardia* (*Parm. stuppea*, Tayl., which can hardly be distinct from *P. endoccina*, Koerb. l. c. p. 36, from Tyrol), are, with more or less certainty, inhabitants of the South of Europe.

Pannaria crossophylla, sp. nov.: thallo minusculo membranaceo glauco-cinerascente e squamulis subelongatis expansis plumoso-multifidis, lobulis linearibus teretiusculis subtus subconcoloribus; hypothallo nigro obsolescente; apotheciis appressis convexis rufo-fuscis biatorinis vel excipulo thallino (spurio) tenui crenato demum subcinctis. Sporæ ellipsoideæ, limbatæ, subincolores, diam. mox 4-plo longiores. — On slaty rocks, Brattleborough, Vermont, *Mr. Russell.* This Lichen, of which I have also received fine specimens from Mr. Frost, appears to differ from all described species in the narrow, teretish divisions of its elegantly branch-lobed thallus, the longer portions of which closely resemble a delicate feather, or (as implied in the Latin terms *plumarius* and *plumatilis*) fine embroidered work, or *lace*. Of the species nearest related, which are all flat-lobed, *P. tryptophylla* differs in the colors, in the lobation of its very flat and thin divisions, and in its apothecia; *P. microphylla* in its closely imbricated crust of small, notched (but "never laciniate-dissected," Fr.) true squamules, and its smaller, *oblong*-ellipsoid spores; and *P. Saubinetii* (Montag.), Nyl., a tree-lichen, of which I have been kindly favored with a specimen by the generous author, in the colors, the distinct configuration of the scarcely lobate, larger, and flatter scales, and, like the last, to which it is much nearer than is the present, in its oblong spores. Beneath, our plant is much of the same color as above, but traces of a blackish hypothallus are more or less discernible at the centre. Apothecia somewhat immersed, bright brownish-red, convex, and the thin, biatorine exciple (which has sometimes an apparent, more or less perfect, crenate, but spurious thalline border) scarcely discernible. Spores ellipsoid, rather sharp at the tips, which are often somewhat elongated; more or less tinged with a hue like that of the gonimous granules; limbate, and the protoplasm commonly separating into irregular, more or less rounded sporoblasts, which are often in polar opposition; from twice to four times longer than wide.

Lecidea microps (Fr. Herb. sub *Parmelia*), sp. nov.: thallo minusculo granuloso-subsquamaceo imbricato glaucescente; apotheciis minimis biatorinis rufescentibus concavis vel excipulo thallino tenui integro receptis. Sporæ octonæ, ovoideæ, incolores, simplices, diam. 2 – 2½-plo longiores. *Lecidea pezizoidea*, Schwein. Herb., non Ach. *Parmelia micrŏps*, Fr. Herb. On the earth, Salem, North Carolina, *Schweinitz*. I possess only a fragment, given to me by Professor Fries, who had it from Schweinitz. The Lichen has points of resemblance to *Lecanora amniocola*, but differs in the spores. It may also be compared with *Lecidea coarctata*, but appears certainly distinct from it. The whole is so small, that an ordinary lens is hardly sufficient to examine its characters; and I offer it here only for further investigation.

Lecidea oidalea, sp. nov.: thallo crustaceo tenui subcartilagineo demum contiguo lævigato rimoso verrucoso-areolato flavo-viridi-glaucescente; hypothallo nigro sublimitato; apotheciis (mediocribus) cupularibus sessilibus nigris disco nudo opaco subscabrido intus albo hypothecio fusco-nigro imposito mox convexo-protuberante marginemque tenuem subobscurum excludente. Sporæ majusculæ, oblongæ, atro-fuscescentes, murali-divisæ, diam. 3-plo longiores. On trunks of Oaks, Alcatraz, California, *Mr. Wright* (U. S. N. Pacif. Expl. Exp.). And I possess a fragment of the same Lichen, from trees on the banks of the Columbia, in Oregon Territory, *Dr. Newberry*. Crust with much of the habit of states of *L. disciformis*, from similar habitats, but greenish; and the margins of the protuberant apothecia perhaps more obscure than in that species. The spores are quite different. These are always without dissepiment, showing at first a grumous protoplasm, which, as the spore attains to its maturity and very dark color, assumes a cellular configuration resembling mason-work, as in *L. atro-alba*, and other species of the same group (*Rhizocarpon*, Koerb.).

Lecidea Africana, sp. nov.: thallo crustaceo adnato radioso-lobato mox squamuloso-areolato, areolis applanatis crenulato-lobatis ambitu rimoso-multifidis lævigatis luteis subtus nigris; apotheciis areolis innato-sessilibus cupularibus nigris, margine tenui crenulato-rugosulo flexuoso, disco opaco nudo intus albo demum convexiusculo subexcluso. Sporæ ellipsoideæ, apicibus acutæ, 1 – 3-septatæ, atro-fuscescentes, diam. $1\frac{1}{2}$ – $2\frac{1}{2}$-plo longiores. On rocks (friable sandstone) on hills near Simonstown, Cape of Good Hope, *Mr. Wright*. Thallus in young plants crustaceous-foliaceous, radiate-lobate; but the centre passing into mostly flattish, areolate, crenulate squamules, which are somewhat palmate-multifid at the circumference, and black beneath; bright-yellow, becoming whitish in some specimens. Apothecia always black; the slightly tumid or obtusish, wrinkled-crenulate margin at length almost excluded by the convex, naked disk, which is white within and rests upon a black hypothecium. Spores smallish, ellipsoid, with rather acute tips, the at first simple protoplasm dividing into two round sporoblasts, and crossed by a central dissepiment; the sporoblasts then divided, and the spore appearing twice or thrice septate, according as the central dissepiment is more or less apparent; finally blackish-brown, and the dissepiments more or less obscure. The Lichen has, at first sight, a good deal of resemblance to *L. geographica*, (as Moug. & Nestl. Cr. Vog. n. 640, *a* & *β*.) but differs in its at first lobulate, at length squamulose and effigurate thallus, and scarcely less in its apothecia and spores, which last are never many-septate. Specimens with more convex lobules occur, and these have something (in miniature) of the plicate aspect of *L. Wahlenbergii*, but the latter is entirely distinct, both in thallus and in its very short and obtuse ellipsoid once-septate spores.

Professor Sophocles read the following communication, —

On the Difficulty of Identifying Plants and Animals mentioned by Ancient Greek Authors.

Few things connected with Greek philology present more perplexity to the scholar than the identification of plants and animals whose names occur in ancient Greek authors. With regard to the Greek naturalists, as a common rule, they were content to mention only some of the most striking peculiarities of plants and animals. Minuteness of observation and accuracy of description were apparently undervalued by most of them. Consequently they had no *technical language*, properly so called; the popular language of the day being deemed sufficiently definite for their purpose. And as each Greek city had its local peculiarities, it was natural that more names than one should be employed to designate a given species. Thus, the *ἀρία* (*Quercus Ilex*) of most of the Greeks was called *φελλόδρυς* (literally *cork-oak*) by the Arcadians.

The definitions of classical names of plants and animals found in later and Byzantine glossarists are to be received with caution; for in many instances they are nothing more than childish conjectures. Thus, according to one of Homer's commentators, *φυλία* is a kind of *olive;* according to another, *a wild olive.* A third tells us that it is a kind of *fig-tree;* and a fourth, a kind of *oak.* Apion supposes it to be a species of *tree.* Ammonius regards it as identical with the *mastic-tree* (*σχῖνος*). Lastly, a scholiast gravely affirms, that *the φυλία is a kind of olive called φυλία!* Again, the *χοιρογρύλλιος* of the Septuagint corresponds to the Hebrew *shaphan* (שָׁפָן). It was one of the animals whose flesh the children of Israel were forbidden to eat. The Jewish doctors of later times imagined it to be the same as the *rabbit* (the *cony* of the English version of the Old Testament). St. Jerome, who lived many years in Palestine, where this animal abounded, describes it in such a manner as to leave very little doubt that it was the *Hyrax Syriacus* of zoölogists. His Italian readers, however, finding that his description of it applied equally well to the *Alpine marmot*, had no difficulty in believing that the χοιρογρύλλιος of the Alexandrian Jews was identical with their marmot. Thus, the Latin glossarist recently edited by Dr. Beck, in his definition of *choirogryllus* (which implies χοιρόγρυλλος, another form of χοιρογρύλλιος), follows St. Jerome in every particular, except one: he refers the animal to Italy (*in Italia abundans*), and not to Palestine. The Byzantines regarded χοιρογρύλλιος, ἀκανθόχοιρος (*hedgehog*), and ὕστριξ (*porcupine*), as synonymous terms.

A considerable number of plants and animals mentioned by ancient Greek authors may be identified with the help of the modern language of Greece, as spoken by the common people, provided the following proposition be admitted; that, *when the ancient name of a plant or animal is still heard among the Greeks, the presumption is that it is the traditional name of that plant or animal.* Thus, there is no reason why the modern μηλιά, *apple-tree*, συκιά, *fig-tree*, ὀξυά, *beech*, φτελιά, *elm*, φιλύκα (also θιλύκι or θλύκι), *Rhamnus alaternus*, πρινάρι or πουρνάρι, *Quercus coccifera*, ἀριός or ἀράδι, *Quercus Ilex*, σφεντάμι, *maple*, should not be regarded as the representatives of the ancient μηλέα, συκέα, ὀξύα, πτελέα, φιλύκη, πρῖνος, ἀρία, σφένδαμνος, respectively. At the same time we must bear in mind that not unfrequently the same plant has different names in different parts of Greece and Turkey. We must remember, also, that the same name is sometimes applied to different species of the same genus, or to different genera of the same order. In some few instances the same name is given even to genera belonging to two different orders. Thus, φλόμος or σφλόμος in most places represents the *Verbascum* of botanists; but in Peloponnesus (if I am correctly informed) it is used with reference to the *Euphorbia* of botanists, elsewhere called γαλατζίδα (from γάλα, *milk*), on account of its *milky juice*.

Ancient Greek names of plants are often heard in regions that have never been under foreign influence, such as the smaller islands of the Ægean, and some of the mountainous districts of European Greece and Turkey. As to the Greeks living among the Turks, they are apt to call familiar objects by their Turkish names. In places once occupied by Slavs, some plants have Slavic names; as βούζι, *dwarf-elder*, from the Russian *buzinà* (bουζηνὰ); λεπουντιά or λοπουντιά or λοβοδιά, *chenopodium*, from the Russian *lebedà* (λebedà).

A compound of ἄγριος, *wild*, in good Greek would naturally denote the wild state of the plant or of the animal whose name appears in the second component part. The Romaic, however, often violates this rule. Thus, ἀγριόλυκος, *wild wolf* (or *savage wolf*), represents the *Bartsia Trixago* of botanists.

Some of the *domestic animals* are called by names once belonging to the dialect of *slang*, as developed in the large cities of the Græco-Roman empire; as πετεινός, *cock*, literally, the *winged* one; ἄλογον, *horse*, literally, the *irrational* animal. A few of them have foreign names; as μουλάρι (diminutive of the mediæval μοῦλα, *mula*), *mule; γάτος*, *cat*, from the Italian *gatto; γάδαρος* (formerly also γαείδαρος, ἀείδαρος), *ass*, a modification of the Persian ἀχδαρι.

With regard to *wild animals*, most of them still retain their ancient names, probably because they were seldom seen in large cities, where linguistic alterations and distortions usually commence. *Fishes* also are often called by their ancient names. For although they were often exposed for sale in the markets of large places, yet their natural history (so to speak) was known chiefly to *fishermen*, a very small portion of the population of the empire, and the last class of men to tamper with language.

President Felton gave an account of the recently-discovered *papyri*, containing portions of the lost works of Hypereides, the Attic orator.

After a general summary of the contents of these interesting documents, which were found in Egypt, and which are now in the possession of the British Museum, he proceeded to discuss the fragments of the Oration of Hypereides against Demosthenes, and the bearings they have upon the charge of accepting a bribe from Harpalus, under which Demosthenes was condemned. He thought the leading points of the argument could be clearly made out from these fragments. In order to set the subject in a proper light, Mr. Felton recapitulated the principal facts in the political history of the times referred to, — sketched the characters of Harpalus, Hypereides, and Demosthenes, and their relations to one another, — and then examined the argument, as presented in the fragments, against Demosthenes, giving the reasons why, under the circumstances of the trial, Hypereides doubtless brought forward everything that could be said on that side. It was shown that Hypereides made the best of a bad cause; that he everywhere assumed the guilt of the accused, pressing into the case collateral topics, with appeals to the popular fears and passions of the moment, so as to weave a web of apparent reasoning out of nothing but surmises, unproved assertions, and vague possibilities; that though the duty of prosecuting was laid upon him officially, there was added the stimulus of personal resentment growing out of recent political collisions; that as no proofs were given, no proofs could have existed; and that the entire line of attack shows that Demosthenes was sacrificed to the terrors of the moment, and to appease the wrath of Alexander.

Chief-Justice Parker discussed the question in the light of the principles of modern law, and sustained the conclusion to which the remarks of President Felton pointed.

Professor Agassiz made the first of a series of communications, which maintain the position that varieties, properly so called, have no existence, at least in the animal kingdom.

Professor Peirce moved, and the motion was adopted, that special meetings for scientific discussion should be held, at the hall of the Academy, on the fourth Tuesday of March, April, and May.

Four hundred and seventy-ninth meeting.

March 27, 1860. — Special Meeting.

The President in the chair.

Mr. J. A. Lowell, Professor Bowen, and Professor Agassiz discussed adversely the hypothesis of the origin of species through variation and natural selection. The latter reiterated his denial of the existence of varieties, properly so called, in the animal kingdom, in the wild state, insisting that what were so called were either stages of growth or phases of cyclical development, and that domesticated varieties were of no account in the matter, having no counterpart in nature.

Mr. Lowell suggested that the supposed varieties in the vegetable kingdom were the result of hybridation. He also criticised the hypothesis in question on scientific and philosophical grounds, and condemned its tendency.

Professor Bowen raised similar objections; contending that this hypothesis is one of cosmogony rather than of natural history, and makes such huge demands upon time, that the indefinite becomes virtually infinite time, so rendering the theory dependent on metaphysical rather than inductive reasoning; he denied the validity of all reasoning from the variability of plants to that of animals, or that the two had enough in common to warrant inferences from the one to the other; he also denied the variability of instinct in any animals, or that there was any evidence of the heritability of variations of structure or instinct except in a few sporadic cases, and in these only for two or three generations. He insisted that there was no reason why, on the theory, instinct and structure should vary contemporaneously; and finally he maintained that the theory denied the doctrine of the permanence of type, as received by all naturalists, was incompatible with the whole doctrine of final causes, and negatived design or purpose in the animate or organic world.

Four hundred and eightieth meeting.

April 10, 1860. — Monthly Meeting.

The President in the chair.

Professor Horsford introduced Mr. Du Chaillu, who, invited by the Academy, gave some account of his travels in Western Africa, and of his observations of the habits of the Gorilla.

Professor Gray criticised in detail several of the positions taken at the preceding meeting by Mr. Lowell, Professor Bowen, and Professor Agassiz respectively; — premising that he had no doubt that variation and natural selection would have to be admitted as operative in nature, but were probably inadequate to the work which they had been put to. He maintained: —

1. That varieties abundantly occur in nature, at least among plants; and that very few of them can be of hybrid origin; that hybridation

gives rise to no new features, but only mingles, and, if continued, blends, the characters of sorts before separate; and that a hybrid origin was entirely out of the question in species which had no congeners, or none in the country to which they were indigenous; yet that such species diverged into varieties as readily as any other. As to the general denial, 1. that there is any such thing as natural selection, and 2. that there is any variation in species for natural selection to act upon, he could not yet conceive how such denial was to be supported; but to answer its purpose it would have to be carried to the length of denying that the individuals of a species ever have anything which they did not inherit; — slight variations, accumulated by inheritance, being just what the theory in question made use of, — taking little or no account of more salient and abrupt variations, though instances of the latter kind could certainly be adduced.

2. In opposition to the view that such variations as cultivation or domestication so copiously affords are of no account in the discussion, and have no counterpart in nature, Professor Gray maintained, that the varieties of cultivation afforded direct evidence of the essential variability of species; that no domesticated plant had refused to vary; that those of recent introduction, such as Californian annuals, mostly began to sport very promptly, sometimes even in the first or second generation; man having done nothing more than to sow the seed here instead of in California, perhaps in no better soil. Here the variations were as natural as those of the wild plant in its native soil. Man produces no organic variation, but merely directs a power which he did not originate, and by selection and close breeding preserves the incipient variety which else would probably be lost, and gives it a choice opportunity to vary more. Consider, he remarked, how small the chance of the survival of any variety when originated in its native habitat, surrounded by its fellows, — when not one seed out of a hundred or a thousand ever comes to germinate, and not a moiety of these ever succeed in becoming a plant, — and when, of those that do grow up and blossom, the danger is imminent that the flowers may be fertilized by the pollen of some of its abundant neighbors of the unvaried type, — and it will be easy to understand why plants vary so promptly in our gardens, mostly raised from a small quantity of seeds to begin with, probably all from the same stock, where they are almost sure to self-fertilize in the first generation, — where every desirable variation is watched for,

and cared for, and kept separate; — and it may be confidently inferred that they vary in cultivation, at first, much as they would have varied in the wild state, if such favorable opportunity had there occurred. Continued cultivation under artificial selection would of course force some of these results to an extreme never reached in nature, giving to long-cultivated varieties a character of their own. Yet they may not deviate more widely from the wild type than do some of the wild varieties of many plants of wide geographical range. Moreover, Professor Gray maintained that there occur in nature the same kinds of variation as those to which we owe our improved fruits, &c.; that such originate not rarely in nature, and develop to a certain extent, enough to show the same cause operating in free as in controlled nature; enough to have shown the cultivator what he should take in hand; enough to render it likely that most of our cultivated species of fruit began their career of improvement before man took them in hand. Instances of such variations in the wild state were adduced from our Hawthorns, especially *Cratægus tomentosa*, from our Wild Red Plum, Wild Cherries, and especially from our Wild Grapes and Hickories.

3. The view taken by Mr. Lowell, and especially by Professor Bowen, that the indefinitely long periods of time which the theory required and assumed was practically equivalent to infinity, and therefore rendered the theory "completely metaphysical in character," Professor Gray animadverted upon, mainly to remark that the theory in question would generally be regarded as too materialistic and physical, rather than too metaphysical in character; and that, *a fortiori*, physical geology and physical astronomy would on this principle be metaphysical sciences.

4. Exceptions were taken against the assumption of such a wide distinction, or of any sharply drawn distinction at their confines, between the animal and the vegetable kingdoms, and especially against the view that instinct sharply defines the animal kingdom from the vegetable kingdom on the one hand, and from man on the other, and which denies to the higher brutes intelligence, and to man instinct.

5. Also, against the view that the psychical endowments of the brute animals, whether instinct or other, are invariable and unimprovable; and a variety of instances were adduced, as recorded in the works of Pritchard and of Isidore St. Hilaire, as well as some from personal observation, in which acquired habitudes or varied

instincts were transmitted from the parents to their offspring. That such acquirements, once inherited, would be likely to continue heritable, was argued to be the natural consequence of the general law of inheritance, the most fundamental law in physiology; that it is actually so, Professor Gray insisted was well known to every breeder of domestic animals.

6. For decisive instances of the perpetuity by descent or fixity, under inter-breeding, of altered structure, Professor Gray adduced Manx cats and Dorking fowls; and he alluded to well-known cases of six-digited people, and the like, transmitting the peculiarity to more than half of their children, and even grandchildren; showing that the salient peculiarity tended to be more transmissible than the normal state at the outset; so that, by breeding in and in, it was likely that *hexadactyles* could soon be made to come as true to the breed as Dorkings.

7. As to the charge that the theory in question denies permanence of type, Professor Gray remarked that, on the contrary, the theory not only admitted persistence of type, as the term is understood by all naturalists, but was actually built upon this admitted fact as one of its main foundations; that, indeed, one of the prominent advantages of this very theory was, that it accounted for this long persistence of type, which upon every other theory remained scientifically unaccounted for.

8. Finally, as to the charge that the hypothesis in question repudiated design or purpose in nature and the whole doctrine of final causes, Professor Gray urged: — 1. That to maintain that a theory of the derivation of one species or sort of animal from another through secondary causes and natural agencies negatived design, seemed to concede that whatever in nature is accomplished through secondary causes is so much removed from the sphere of design, or that only that which is supernatural can be regarded or shown to be designed; — which no theist can admit. 2. That the establishment of this particular theory by scientific evidence would leave the doctrines of final cause, utility, special design, or whatever other teleological view, just where they were before its promulgation, in all fundamental respects; that no new kind of difficulty comes in with this theory, i. e. none with which the philosophical naturalist is not already familiar. It is merely the old problem as to how persistence of type and morphological conformity

are to be reconciled with special design, (with the advantage of offering the only scientific, though hypothetical, solution of the question,) along with the wider philosophical question, as to what is the relation between orderly natural events and intelligent efficient cause, or Divine agency. In respect to which, we have only to adopt Professor Bowen's own philosophy of causation, — viz. "that the natural no less than the supernatural, the continuance no less than the creation of existence, the origin of an individual as well as the origin of a species or a genus, can be explained only by the direct action of an intelligent cause," — and all special difficulty in harmonizing a theory of the derivation of species with the doctrine of final causes will vanish.

Professor Parsons made a communication upon the general subject. He remarked that: —

The new theory rested wholly on the assumption that the changes or variations by which the author supposed that species were established, were always minute, and effected their purpose only by accumulation through ages. But Mr. Parsons regarded this as wholly unnecessary. The records of monstrosity show that aberrant variation, in the direction of loss or degradation, may go very far indeed. And we have no reason whatever for holding it to be a law, that aberrant variation may not, possibly, in some instances, go equally far in the direction of gain and improvement. Supposing this to be possible, we reconcile the theories of Darwin and Agassiz. Admitting all the new creations which Agassiz requires, the question then occurs, How are these creations created? We must choose, either chance, and chance is a word only and not a thing, or creation at once out of nothing, by creative will; or from earth and water and chemical elements summoned to a proper place, at a proper time, in proper proportions, by the same exertion of Omnipotence. One of these we *must* choose, or else accept the theory that these new creations were created by means of some influence of variation exerted upon the ovum of some existing kindred creature, either before or at conception, or during uterine nutriment. This last supposition Mr. Parsons deemed by far the most reasonable and philosophical. Thus, if we suppose that the time had come for a dog to exist for the first time, and become the father of all dogs, it is far easier to believe that he was born of a wolf, a fox, a hyena, or a jackal, than that he suddenly flashed into existence out of nothing, or from a few pounds of chemical elements. Mr. Parsons then remarked upon some of the facts in geology that seem to favor this view; particularly the noticeable circumstance, that, as the great classes of animals succeed each other, they are not separated by periods of nothingness, but lap over each other, and are joined by connecting links. By way of illustration, he referred to trilobites, which run up through all the paleozoic rocks; and as they are beginning to thin out, we have in the old red sandstone the Pterichthys and the Cephalaspis, which was long held to be a trilobite of the genus of Asaphus, until Agassiz determined both to be fishes; and Mr. Parsons quoted Murchison's statement, that he regarded them both as the connecting links between the Crustacea and the fishes. So after fishes were well established, we have the Placodus, the Dendrerpeton, and the Archegosaurus, all of which were for some time held by Agassiz to be fishes, but, upon further and final investigation, were determined by him to be reptiles; and these may therefore be regarded as the connecting links between fishes and reptiles,—between marine animals and land animals. So, the line between the Protozoa and the Protophyta is constantly shifting and uncertain. And in the same connection, Mr. Parsons adverted to the singular fact, that man, who begins in the uterus as a nucleated cell, or monad, on his way to birth puts on the traces and characteristic indications of all the great families of animals. Asserting that the time had come when science must either adopt the doctrine of creation out of nothing, or else admit that new creatures may exist as the aberrant offspring of kindred parents, he preferred the latter; nor did he think that reason or religion would be shocked if science should hereafter declare it probable, that the earliest human beings were not called into existence out of nothing, or directly from the dust of the earth, but were children of Simiæ nearest in structure to men, and were made, by some influence of variation, to differ from their progenitors in having a brain and general structure such, and so formed, that the breath of immortal life could be breathed into them, and distinguish them for ever from the animals from whom and above whom they had risen.

Professor Bowen replied at length to the arguments and criticisms of Professor Gray, but reserves his remarks for publication in another form.

Four hundred and eighty-first meeting.

April 24, 1860. — Special Meeting.

The President in the chair.

The Corresponding Secretary read letters relative to the exchanges of the Academy.

Mr. S. Newcomb read a paper on the secular variations and mutual relations of the orbits of the Asteroids, of which the following is an abstract: —

The tests to which it is possible to put any theory respecting the common origin of the asteroids may be divided into two classes. The one is *per se* demonstrative, and consists in determining by actual trial whether the orbits of the asteroids could ever have fulfilled the conditions which may be required by the hypothesis. It may, however, be subject to practical difficulties in its applications, which impair its demonstrative vigor.

Another method is furnished by the method of probabilities, and might, perhaps, if the asteroids were sufficiently numerous, approach very nearly to certainty in its results. It is founded on the supposition, that the hypothesis examined will imply a high probability of some general relationship among the orbits of the asteroids, if the latter are sufficiently numerous; and consisting in observing whether any such relationship is observable between the elements of the asteroids.

Take, for example, the hypothesis of Olbers. It seems highly probable that, if this hypothesis be true, the fragments of the exploded fragment would have been thrown promiscuously in every direction; and that the velocities of those thrown in one direction would not differ materially from that of those thrown in another. From this hypothesis we easily deduce the following conclusions: —

1. The exploded planet, supposing it to have moved in an orbit with a small eccentricity, was at a distance from the sun about equal to the average distance of the asteroid, or 2.6.

2. The asteroids, of which the mean distance is nearly equal to 2.6, ought on the whole to have much smaller eccentricities than those at a greater or less distance.

3. The eccentricities ought on the whole to be more than twice as great as the inclinations; and the average quantity by which the mean

distance differs from 2.6 should be about 5.2 times the inclination, or 2.4 times the eccentricity.

Now, the orbits of the asteroids are very far indeed from fulfilling either of the last two conditions. The mean value of the eccentricities is almost exactly the same as that of the inclinations, and the variations in the mean distances are much less than they ought to be.

Again, it would seem highly probable, on Olbers's hypothesis, that the smaller fragments would be projected with greater velocities than the large ones, and would thus be found to have larger eccentricities, inclinations, and ranges of mean distance. Such, however, is not found to be the case.

The orbits of the asteroids do not seem to have been materially affected by a resisting medium. Such a medium would affect the smaller ones more than the larger, and thus cause the former to approach the sun more rapidly than the larger. But no tendency among the smaller asteroids to be near the sun is observable, other than what proceeds from the less brilliancy (and consequently less susceptibility of discovery) of the more distant ones.

It has frequently been remarked, that a large majority of the asteroids have their ascending nodes and perihelia in the first semicircle of longitude. This fact throws no light on the question of their origin, since it is the almost necessary effect of known causes. The principal cause is the attraction of Jupiter; and the effect may be expressed by saying that there will always be a tendency in the nodes of the asteroids to coincide with the node of Jupiter, and in the perihelia of the asteroids to coincide with that of Jupiter.

It is possible that the hypothesis that the asteroids were formed by the breaking up of a revolving ring of considerable eccentricity and inclination might account for the general relations of their elements.

Dr. I. I. Hayes, of Philadelphia, addressed the Academy, by special invitation, upon the subject of his proposed expedition to the Arctic Seas. He was introduced by Dr. B. A. Gould, who said: —

More than eighteen months ago, upon the first announcement by Dr. Hayes of his desire to organize an expedition to the North Polar regions to complete the work of the Grinnell expedition under Dr. Kane, resolutions were unanimously passed by this body, commending his daring and self-sacrificing plans, and offering him the sympathy and influence of the Academy; appointing at the same time a committee of seven Fellows for the purpose of co-operating with him, and of rendering him scientific aid and counsel. The efforts of Dr. Hayes to obtain the equipment for his expedition last year were unsuccessful, and he is now engaged, as the Academy is aware, in renewed efforts to obtain means of conducting a party of exploration to the Arctic Pole, and of thus definitely solving the chief geographical problem of our times, — that of the supposed open Polar Sea, its boundaries, approaches, physical characteristics, and the vegetable and animal inhabitants of its shores and waters.

It may, I think, safely be said, that the great majority of scientific men believe in the existence of such an open sea around the North Pole, for reasons of various kinds, with which the Academy is familiar, — reasons derived from the course of the Gulf Stream, from known habits and habitations of the whales, from the form of the isothermal lines, and from various reports of different explorers since 1810. The evidence brought back by Dr. Kane's expedition tended strongly to corroborate this belief in the public mind; and now, guided by the experience and discoveries of that expedition, Dr. Hayes proposes to aim directly for the Pole, to complete the work so brilliantly begun by the Grinnell expedition, and to secure for our own land the honor which such an enterprise, successfully conducted, cannot fail to receive.

At our last meeting Dr. Hayes was, by a unanimous vote, invited to address the Academy this evening upon the subject so near his heart, and in acceptance of this invitation he is here. He naturally desires to enlist the immediate personal interest of gentlemen present, in behalf of his plans, that their influence may aid him with the community to which he proposes to appeal for help.

Of the feasibility of the exploration, of the extent to which our present experience promises to enable us to surmount difficulties hitherto encountered, of the details of the plan which he has so carefully matured for the equipment of a party and the prosecution of his undertaking, Dr. Hayes will speak. But before taking my seat, I beg leave to urge one important consideration upon the notice of the Academy, namely, the great danger that, if the efforts of Dr. Hayes are unsuccessful in organizing his expedition during the present season, the opportunity may be lost to our country. The Arctic service is extremely popular in the British navy; a large number of living officers have participated in the searches for Sir John Franklin, and have thus become familiar with the peculiarities of navigation in high latitudes; and at this very time efforts are making on the other side of the Atlantic for exploring these untraversed regions of our own hemisphere. If this expedition be not equipped at present, there is every reason to believe that a European one, next year, upon a larger scale, will supersede it; and that the discoveries and explorations which now reflect such lustre upon the names of Kane and of Grinnell may be thrown into the background by the achievements of those who, while profiting by their experience, may yet overshadow their record. An American expedition ought to be equipped now; and if equipped, who should lead it but Dr. Hayes? What other living citizen unites the experience with the knowledge needed for the enterprise? Those of us who have read his modest narrative of that heroic boat journey towards Upernavik will appreciate that union of chivalry with caution, of daring with discretion, so important for the leader of a hazardous enterprise. They will remember the boldness, the tact, the nerve, and the thoughtfulness which were so conspicuous in that memorable journey.

Dr. Hayes comes to us supported by the commendation of the leading institutions and men of science throughout the land, and bringing their earnest desires for his success in carrying out his heroic aims. His hopes now rest upon Boston, and it remains for our own city to say whether he shall lead his daring company northward.

Permit me now, Mr. President, to introduce Dr. Isaac I. Hayes, surgeon of the late Grinnell expedition under Dr. Kane.

Dr. Hayes then spoke substantially as follows: —

I am highly honored, Mr. President, by the invitation which the Academy has extended to me; and am greatly gratified at having this opportunity to bring to your notice the plan which I have proposed for continuing the researches of the late Dr. Kane. With Dr. Kane's scheme of exploration you are already quite familiar. It was based upon the idea that the great Arctic ice-belt was more readily traversed through Baffin's Bay and Smith Strait than in any other region. He was arrested by the ice at Rensselaer Harbor, in latitude 78° 37′, on the eastern side of Smith Strait. Here he passed the winters of 1853 and 1854. During the summer of 1854 he conducted his explorations over the ice northward, with sledges; and finally discovered open water north of the ice-belt. This was traced to latitude 81°, and beyond this point no ice was seen. Dr. Kane's position was an unfavorable one, from causes which will be readily perceived, upon a reference to the map. Smith Strait runs in a northeasterly direction, and diagonally to the general direction of the current which sets south through Kennedy Channel. This current piles the ice upon the Greenland coast, and breaks it into confused ridges; in consequence of which obstruction, Dr. Kane's parties were greatly embarrassed in their efforts to surmount these hummocks.

I propose to avoid these difficulties by selecting the western shore, where we shall find a protection against the drift-ice; and, in consequence of this protection, hope to attain to a higher latitude than was attained by Dr. Kane on the opposite side. Along this shore I think it not impossible that, under the protection of the land, it will be possible to penetrate into Kennedy Channel, and through this to find a water communication to the Pole. In any case I feel well assured that the parallel of Cape Frazer, lat. 79° 42′, can be reached, and here a fine harbor can be secured for wintering. Thence northward the coast presents no salient capes to arrest the ice, and we shall doubtless meet a favorable field for our sledge travel. We shall remain mainly inactive during the winter; but before the earliest return of sunlight in the spring we will push forward our provision depots with dog-sledges, and early in April a boat mounted upon runners will be started. With this equipment we can continue to move northward until we have met the object of our search, when, if such fortune awaits us, we will launch our little vessel and push off directly for the Pole.

That we shall meet the open water, I have no doubt. It may not be found as far south as when discovered by Dr. Kane, (namely, lat. 80° 20′,) for we shall be nearly two months earlier in the season; but we can readily convey our full equipment over the ice, in the manner already described, as far as latitude 83°, when we shall probably be obliged to await the disruption of the ice.

While these operations are going on, I shall, if found practicable, dispatch parties to the eastward and westward, with the view of completing the survey of the northern coasts of Greenland and Grinnell Land. The region covered by these several parties will be a most important one for scientific surveys. I need not in this presume to dwell upon the vast importance of the observations which may there be collected, upon the magnetism, meteorology, natural history, and general physics of the globe.

The difficulties which will be encountered are far less than those which have attended Arctic exploration in former years. The experience of the English and American explorers during the last twelve years, while prosecuting the search for Sir John Franklin, has reduced Arctic travel almost to a science. The dogs are a powerful auxiliary, and, by using them almost wholly for draught, I shall be obliged to take only a small number of men. The ice which embarrassed Dr. Kane is readily avoided by avoiding the crossing of Smith Strait. The cold is no longer an obstacle to successful travel. The scurvy, hitherto a great scourge to crews of vessels wintering in the Arctic Seas, is now readily resisted, by the abundant use of such food as can now be readily obtained and preserved quite fresh. From this disease and from all other causes combined, the mortality on board of the vessels which have gone in search of Franklin, during the past twelve years, has been less than three per cent of the whole number of persons engaged.

In concluding, Dr. Hayes thanked the Academy for the courteous hearing which they had given him.

Professor Agassiz expressed himself warmly in favor of the enterprise. It would, if successful, bring to us data which were much needed in almost every department of science. Everything seemed to indicate the existence of an open Polar Sea. The Gulf Stream flowing northward beyond Spitzbergen would carry warm water into the Arctic Basin, and there was every reason to suppose that the bed of the ocean was much depressed in the region of the Pole, and that the existence of land in that quarter was counter-indicated. If there is no land there, it is not probable that there is much ice. In support of his view, that at the centre of the Arctic Ocean the water is very deep, Professor Agassiz called the attention of the Academy to the fact, that the lands investing it are found to descend rapidly from the crests of the great mountain ridges of the northern hemisphere, in both its eastern and western divisions.

If Dr. Hayes could make in those high northern latitudes collections of the lower forms of animal life, they would have exceedingly great value. Indeed, there is scarcely any quarter of the world that would yield richer results to an earnest naturalist.

Professor Agassiz regarded the question as in a certain sense an American one, and thought that since an American, Dr. Kane, had been the first to penetrate to the Polar Sea through Smith Strait, it is the duty of Americans to carry on the work.

Professor Lovering, chairman of the special committee appointed in October, 1858, for the purpose of co-operating with Dr. Hayes, stated that three vacancies had occurred in the committee by death or removal from the State, and moved that these be filled by the chair. This having been done, the committee was announced to consist of the following gentlemen : —

Prof. Joseph Lovering,
Hon. Nathan Appleton,
Prof. Theophilus Parsons,
Edward Wigglesworth, Esq.,
Prof. H. L. Eustis,
Dr. B. A. Gould, and
Theodore Lyman, Esq.

Professor Lovering then offered the following resolutions, which were unanimously adopted : —

Resolved, That the Academy has heard, with great interest and satisfaction, the development and explanation by Dr. Hayes of his plans for a continuance of the explorations commenced by Dr. Kane, and takes this occasion to renew the expression of its approval and sympathy.

Resolved, That the Academy commends the enterprise proposed by Dr. Hayes to the favor and support of the American people, and most cordially joins in the commendation bestowed upon it by other institutions of science throughout the country.

Resolved, That the committee, hereafter appointed to co-operate with Dr. Hayes, be authorized to take such action as they may deem expedient for promoting the interests of the proposed expedition, and that they be requested to co-operate with any other committees appointed for a similar purpose.

Professor Agassiz mentioned the fact that Smelts (*Osmerus viridescens*) were about sixty years ago introduced into Jamaica Pond, and that they still exist there in a thriving condition.

A desultory discussion ensued upon some questions relative to the inheritance of acquired habits, and the reversion of feral animals to the original state, in which Professors Bowen, Agassiz, Wyman, Gray, and Dr. Kneeland took part.

On motion of Professor Bowen, it was voted that the special meeting appointed for the 22d of May be held on Tuesday, the first day of May.

Four hundred and eighty-second meeting.

May 1, 1860. — Special Meeting.

The Vice-President in the chair.

Professor Gray resumed the discussion upon the questions mooted at the preceding meetings, in a rejoinder to Professor Bowen's last remarks.

Premising that he had never accepted the Darwinian theory of the origin of the species as anything more than a legitimate hypothesis, just beginning to stand its trial, and that he had been occupied only in the endeavor to expose and rebut what he thought inconclusive or irrelevant arguments here brought against it, Professor Gray defended and illustrated the positions he had before taken. He maintained that no thoughtful theistic philosopher, and least of all, Professor Bowen, could be justified in charging that a theory of the diversification of species through variation and natural selection was incompatible with final causes or purpose; that the argument for design from structure and adaptation, in the case of any animal, say a dog, took all its validity from the consideration of the animal itself, wholly irrespective of its origin, — was as valid in the instance of an individual dog produced by natural generation, as it would have been in the case of the first dog if suddenly presented for inspection; that, if the argument for design is not weakened because our dogs are known to come from similar parent dogs, nor because Newfoundland dogs were derived from mastiffs or some other variety many years ago, neither would it be weakened if both varieties, and many others, came from some species of wolf, as is the prevalent opinion, nor if this wolf were derived from some post-tertiary or tertiary wolf, and this from some earlier one, the remote ancestor of all existing wolves and dogs; that it is all the same *as to the argument for design*, this resting on the adaptation of structure to use, irrespective of the particular manner in which the adaptation may be conceived to have been brought about. He also insisted, that no theist is entitled to hold that the so-called *accidental* element in natural selection negatives design, though it may render it more difficult to prove design in opposition to the atheist; and he adduced a series of analogies and parallels from the relations of one animal to another and to plants, — from the relations of both to the inorganic world, — from the gradual preparation of the earth's surface, in the theist's view, for man's existence and well-being, — from the evolution of our solar system, and the development of the actual state of our planet, which no one now doubts was a progressive development, while most theists consider the results not only as compatible with design, but as, in the largest sense, designed results, — as all showing that the argument he was opposing, if it proved anything, proved far too much. To the objection, that, while a variation which was an improvement survived through natural selection, a vast number being no improvements, but perhaps the contrary, perished, — that the latter "were therefore useless, if not injurious, therefore without a purpose, without a final cause," — and therefore that the theory negatived design altogether, — Professor Gray replied, that the same might be said of the vast number of rain-drops which were raised from the surface of the ocean only to fall back into it, while a smaller number, wafted inland, supported vegetable and animal life; and also of the vast proportion of pollen and sperm, which were designed to impregnate ovules and ova, and of seeds, eggs, &c., which, though potential plants and animals, perish undeveloped, and are therefore purposeless in the same sense, and only in the same sense, as are the unimproved, unused, or unperpetuated variations referred to.

As to the relation of theories of origination to efficient and intelligent cause, Professor Gray remarked that the question was mainly as to the way in which we may suppose creative power to be exerted, and upon what exerted, — whether always upon nothing to evoke something into existence, and this repeatedly, when small alterations would make all the difference between successive species. And enumerating the three, and only three, general views of efficient causation which may claim to be both theistic and philosophical; — viz.: 1. that of its exertion at the beginning of time, endowing created things with blind forces which produce the phenomena; 2. the same view, with that of insulated interpositions, or occasional direct Divine action, engrafted upon it; and 3. that of the constant and orderly immediate action of an intelligent creative Cause; — Professor Gray insisted that Professor Bowen, in adopting the latter view, was precluded from bringing the objections he did against the new theory; that the difference between Professor Bowen's and Mr. Darwin's view was thereby reduced to this: the one asserts that the origination of an individual, no less than that of a species, requires and presupposes Divine power as its efficient cause; the other, that the origination of a species is natural, no less than the origination of an individual; — propositions which do not appear to contradict each other.

Professor Gray then entered upon various questions of fact and of detail, and also insisted that, if psychologists would scrutinize facts of observation as they had those of consciousness, they would not confound together all the psychical manifestations of the brute animals as one faculty, but would discriminate (as they largely might) between their instinct, which prevails in the lower, and their intelligence, which is manifest in the higher animals. In respect to the proper intelligence of the latter, he adduced the very explicit and unqualified published testimony of Agassiz; and the fact of the heritability both of acquired habits and aptitudes, and of certain modified structures, was supported by additional examples.

Professor Bowen replied at length, but furnishes no abstract, and the discussion was continued by Professor Agassiz, and others, in incidental remarks. Also in a written note, contributed by Dr. Kneeland, as follows: —

At the last meeting of the Academy I stated my impression that Mr. Gordon Cumming, in the chapter referred to by Professor Bowen, as to the barking of the wild dogs in Southern Africa, had intimated that they might be feral dogs, or dogs once domesticated and afterward becoming wild. That I find is not the case; as in Vol. I. p. 152 (note), he makes no allusion to a feral condition, distinctly calling them "wild dogs." But what is the extent of the argument that can be drawn from his authority as to the fact of wild dogs barking? In the first place, if it be argued from this that wild dogs bark, the argument would seem to go too far; for the reason that the wild dogs seen by Cumming and other travellers are not what we should call *dogs;* in fact, Cumming says (p. 152) that these animals seem "to form the connecting link between the wolf and the hyena;" this quotation indicates the so-called dogs to belong to the genus *Lycaon*, like *L. venaticus*, the hunting hyena, a canine animal, but hardly more a dog than a hyena.

He says that these dogs kept up a "chattering and growling," making most unearthly sounds, and barking "something like collies;" but he does not tell us how nearly this resembled the barking of collies, nor what is the bark of collies. Such indefiniteness of language is very poor proof that his wild dogs *barked*, in the common acceptation of the term. On another page of the book he is more definite, and says that the voice of these wild dogs consists of three different kinds of cry, each of which is used on special occasions: — first, a sharp, angry *bark*, uttered when they suddenly behold a strange object; — second, a kind of chattering, like a number of monkeys, or men conversing when their teeth are chattering violently with cold, emitted at night when excited by any particular occurrence, "such as being barked at by domestic dogs;" (in regard to this the question arises, if the bark be natural to them, why do they not return the compliment of domestic dogs by *barking* instead of chattering?) — and third, the most common, a rallying note to bring the members of the pack together, — soft, melodious, and distinguishable at a great distance, like the second note of the cuckoo. Still, no great proof that these dogs barked, as the term is generally understood.

All canines have a natural voice, which may in certain cases resemble a short, snapping bark, as in the prairie-wolf, the fox, &c.; but no one would be likely to confound this with the monotonous, oft-repeated note of the domesticated dog. Though domesticated dogs would be expected to howl like a wolf, or snap like a fox, or utter other natural canine noises, according to their derivation, when terrified or in pain; we have no right, on the contrary, to expect, and there is no decided proof that we do find, in wild canines, other than feral dogs, a true bark.

The bark is the language of the domesticated dog, and by it he expresses the various emotions of joy, anger, fear, or suffering; and, as in human language, it must have been the work of ages to develop canine education to the point of a domesticated bark.

As far as Cumming goes, then, there are no proper wild dogs in Africa, but only jackals, hyenas, and lycaons, which may on rare occasions make noises which the vivid imagination of a Cumming might magnify into the bark of a collie.

Taking the word *bark* as we generally understand it, there seems no reason to affirm that wild dogs bark, any more than that wild felines mew; and it must be a very acute sense of hearing that would detect the bark of the dog in the voices of the wolf, fox, and jackal, or the mew of the cat in the growls of the lion and tiger. Though it be a difference of degree and not of kind, it is precisely the degree brought about by domestication alone. Even the half-civilized Esquimaux dog does not bark, his education not having reached that degree of refinement.

Comments were offered by Professors Bowen, Agassiz, Gray, and others.

The subjoined abstract of Mr. J. A. Lowell's remarks belong to a preceding meeting, and should have been introduced on page 410.

Mr. Lowell said that the book recently published by Mr. Darwin on the origin of species had deservedly attracted great attention, both in this country and in Europe. It is written with admirable candor, and rests on an ample and patiently accumulated collection of facts. Had the author, however, confined himself to the subject indicated in his title-page, his work would scarcely have inspired such universal interest. It is because he has unfolded a new theory of creation, that his views are espoused or combated with so much zeal. His facts are apparently, for the most part, uncontroverted; and it is precisely this admission of the facts that takes the inquiry from the exclusive domain of science, and opens it to all who are qualified to examine it merely as a deduction from acknowledged premises. The argument may be summed up in this: —

1. The intervention of man has produced, by careful and continued selection, very remarkable changes in races both of domestic animals and plants.

2. Nature constantly produces varieties. Therefore,

3. Nature, which commands indefinite periods of time, may, by seizing accidental varieties in which some peculiarity appears favorable to the individual in the great struggle for life, so extend and improve this peculiarity as gradually to evolve new and more gifted species.

It was clear that he could not logically stop here, and he does not shrink from the conclusion, that in like manner genera have been evolved from species, orders from genera, and so on, until at last you come back to one original pair, progenitors of all the visible animated creation.

To this reasoning Mr. Lowell objected: —

1. That man acts with means of seclusion that Nature does not possess, and that accordingly varieties always tend to return to the original type, instead of diverging from it.

2. That the changes produced by human agency are all within *specific* limits; that is, that the operation consists in developing certain observed tendencies, and discouraging others; but that there is not the slightest approach towards *generic* changes. The most improved Southdown ram, or Ayrshire bull, is but a ram or a bull after all. You cannot, therefore, reason from this analogy, whatever time be assumed, to any changes differing in *kind* from specific changes.

3. The theory rests entirely on the second proposition, that Nature is constantly producing varieties. Mr. Darwin must therefore be held to strict proof of this. The existence of varieties in the animal kingdom is denied by very high authority. As to the vegetable kingdom, so long as botanists took it for granted that all hermaphrodite plants were self-fertilized, every departure from the normal type was of course a variety. But Mr. Darwin has shown by numerous instances that fertilization is constantly occurring by the intervention of insects, who transport to one flower the pollen of another, and that this occurs not only between plants of the same species, but also between those of different species. He even doubts whether any species can be long maintained by self-fertilization alone. Such being the case, it becomes a legitimate subject of inquiry whether all the so-called varieties are not produced by hybridization. We know that, in crossing breeds, one offspring will resemble one parent, one the other, and others have a type

intermediate between the two. May not all the forms which seem to link one species with another be explained on the same principle?

4. The use of the word *accidental* in this connection is not warrantable. For the question will resolve itself at last into a question of design, and the use of this word is therefore a begging of the matter at issue.

5. If geological investigations showed an ascending series, while the lower forms were *extinguished*, there might be some ground for this theory; though even then it might be difficult to conceive why in all cases the intermediate forms were wanting in the great record. But forms of the lowest type are as frequent now as ever; the Lingula lives at the present day in perfect harmony with the Clam, which should have superseded it.

6. The word *indefinite*, as applied to time, has no clear meaning to distinguish it from *infinite*. A million or ten millions of years would not be an indefinite period. Now we know some of the properties of the infinite, as in the case of the summation of series; but the idea of infinity itself we cannot grasp, and we have no right to invoke it in the solution of any finite question.

7. Long as are the periods established by geology, the author is obliged to resort to a much longer time to account for the development of such a curious and exquisite organism as that of the eye from a mere nervous thread *accidentally* sensitive to light. For in the earliest stratified rocks the Trilobites are already gifted with complex organs of vision, and that comparatively modern animal, the Ichthyosaurus, has an eye that any reptile at the present day might envy.

8. A yet more serious objection lies against the evidently forced and painful attempt to trace the development of reason from the lower forms of animal instinct. With regard to man, so recent has been his introduction on the earth, that we might reasonably expect to find the intermediate forms which must have existed between him and the anthropoid apes.

9. The whole theory rests on the assumption, that there may be forms more favored and better fitted to succeed in the struggle for life, than those originally created. But is this proved? Observe, that as fast as any species, by this theory, improves, just so fast its enemies must improve also. While Nature avails itself of an accidentally harder proboscis, to enable an insect, now become a borer, to lay its eggs within

the tree, that the young larvæ may avoid destruction, — the bird, meanwhile, is by a like careful selection, acquiring claws fitted to climb, and a beak fitted to pierce the bark, and so has become a woodpecker. After all the prolonged and patient efforts of Nature, through countless ages, the relative numbers remain precisely at the point from which they started.

Finally, if this theory is true, it should be carried much farther. For why stop at the limits of human vision? Why at those of the best microscopes? Why even at those which we may expect the microscope ultimately to attain? Beyond and below these, there may exist myriads of forms, myriads of created organisms, equally entitled, on all principles of reasoning, to claim that they have been formed in the image of that original pair.

Four hundred and eighty-third meeting.

May 8, 1860. — MONTHLY MEETING.

The PRESIDENT in the chair.

Dr. Kneeland, in reference to some criticisms which his communication at the last meeting, upon the barking of dogs, had called forth, remarked, —

That, as regards the testimony adduced, which he said was the same as had been extolled on the other side of the question, he had introduced the testimony of the same hunter-naturalist, and his only, to show that the wild dogs in question were widely different from the common type of dogs, and that their voice could not be fairly compared to the educated bark of domesticated dogs.

As to the occurrence of indigenous wild dogs south of the Equator, he maintained, on the authority of Hamilton Smith and others, that the South American wild dogs are aguara or fox-dogs, and not true dogs; and also, on the authority of many naturalists, that the South Pacific dogs have been introduced from the Asiatic continent by their Polynesian masters; that, according to Dr. Pickering, there is probably no aboriginal dog in New Zealand; that the dogs of the Namaqua region in Southern Africa, on the authority of Anderssen, are half-reclaimed jackals; and that the Australian dingo, an exception to the zoölogical character of that region, on the authority of Dr. Carpenter and others, is more likely to have been introduced from Asia, and to be the progeny of the Indian dhole, (rendered the more probable by the wolf-like characters of the dingo,) than to be the sole indigenous, carnivorous, placental mammal on that continental island. Seeing that it must be a mere matter of opinion, he considered the question of the occurrence of indigenous wild dogs south of the Equator as at best still *sub judice.*

Mr. C. Wright made some remarks on the architecture of bees, in reference to previous discussions upon the instinct of the honey-bee.

Mathematicians have regarded the economical characteristics of the honey-cell too exclusively, to the neglect of those symmetries which Maraldi pointed out.

The more prominent of these symmetries are the regularity of all the solid angles of the cell, and the consequent equality of all the angles made by the sides and rhombs with each other to 120°, or to $\frac{4}{3}$ of a right angle. Another important symmetry which follows from these is seen in the position of that point in the axis of the cell which is directly over the middle points of the rhombs; for this point is at the same distance from all the nine planes of the cell, and just opposite similar points in the nine contiguous cells; so that little spheres which would just fit the honey-cells would, if pressed to the bases of the cells on both sides of the comb, touch the rhombs in their middle points, and the sides in their middle lines, by points in the spheres themselves, at which they would touch each other but for the thickness of the intervening walls.

While the common mode of considering the form of the honey-cell regards it as the effect of rational economy, these symmetries show how the cell might be the natural result of simple or sensible economy, as applied to the building of simple nests, the common type of which is a cylindrical cavity with a hemispherical base. The construction of a series of such nests side by side, and with the bases of two opposite series in closest contact, would, by the simple removal of the interstitial material, result in two series of cells like the normal ones of the honey-comb, both in the forms and the arrangement of the sides and bases. Hence, as the bee builds the two series of cells from their common bases, making the incipient depressions on one side form the interstitial elevations around the cavities of the other side, and as it builds by continual trimming and saving, we may infer that the form of the honey-cell does not require, in the bee's instinct, any reference to supersensible properties of form, but only a reference to sensible economy and facility of construction; especially as no one would contend that the utility, to innumerable nest-building animals, of spherical and cylindrical surfaces, depends upon their economy (which is still greater than that of the honey-cell), rather than upon their far more obvious symmetries and facilities for construction. It appears, therefore, that the instinct of the bee does not differ in kind from instincts in general.

Mr. Newcomb discussed the objections raised by Mr. Mill, and others, against Laplace's presentation of the doctrine of probabilities.

Many objections have within late years been brought against the fundamental basis of the theory of probabilities as laid down by Laplace. Some of these proceed from an entire misapprehension of the mathematical and logical signification to be attached to the term *probability;* others from a defect in Laplace's theory considered as a philosophical structure, which, although not necessarily leading to any error in the treatment of any special problem, has nevertheless been adduced as a reason why Laplace fell into the assumed mistakes. However, as it is conducive to sound reasoning to have the fundamental principles of every deductive science laid down with as much logical clearness and accuracy as possible, let us first consider the question, What is probability?

The probability of a proposition has sometimes been defined as the *amount* of our belief in the truth of that proposition. Here, however, a difficulty arises from the fact, that neither belief, nor any other affection of the mind, admits of being measured as a *quantity.* We may apply the terms greater or less to belief, but we cannot say *how much* greater or less. Nor does this inability proceed from the imperfection of the faculties, as when we experience a difficulty in determining by the feeling whether one weight is twice as heavy as another. It is inherent in the nature of things. In order that we may say of one thing that it is twice as large as another, we must be able to conceive of it as susceptible of division into two independent parts, or as formed by the superposition of two such parts, each of which can be considered separately. Now it is obvious that belief cannot be considered as formed by the superposition of several less beliefs.

But although belief itself cannot be considered as a quantity, we may submit to mathematical computation those combinations of circumstances which induce partial belief. The whole mathematical doctrine of probabilities may be considered as founded on the following definition: —

If of m events *one* and *one only* must occur (or have occurred); and if an individual is entirely ignorant of any reason why one of these events should occur rather than another, and if n of these events belong to a class A, then we call the fraction $\frac{n}{m}$ the *probability*, for the mind of the individual in question, that the event which will occur, or has occurred, belongs to the class A. The probability might equally have been expressed by the fraction $\frac{n}{m-n}$; but this would be less convenient for mathematical computation, although *more* in accordance with the language of common life.

The solution of every possible mathematical problem in probabilities consists simply in determining, from the conditions of the question, the values of m and n, or rather of their ratio.

It will readily be perceived that probability, as thus defined, (and this is equivalent to the usual definition,) is not a quality inherent in the event itself. The latter may be determined by laws as exact as those which regulate the motions of the heavenly bodies. The principle that every event which occurs is the result of law, and neither has or ever had any *absolute* uncertainty inherent in it, may be regarded as an induction almost as perfect as the laws of motion.

Suppose that a die is loaded on one side. As long as we are entirely *ignorant* of any reason why the load should be on one side rather than another, the probability of any one side turning up will still be $\frac{1}{6}$ by definition. If we found the same side of a die to be thrown four times out of five, we should be disposed to inquire whether the frequency with which it was thrown was the result of *chance* or of *law*. Expressed in exact philosophical language, our question should be as follows: —

Were these successive sixes the result of separate and independent causes, conditions, or determining reasons?

Or was there a common element in the causes or determining reasons which produced them?

But, it may be asked, is not the shaking of the box by the same individual in either case a common element in the causes of all the throws?

I answer, that we are not to look for the common element in those causes which are concerned only in producing the whole class of effects, the relationship of which we seek; but in those *additional and unknown* circumstances which determine why *one* of these effects should be produced rather than *another*.

Now, the shaking of the box is supposed simply to cause the result,

A side is thrown,

while the cause of the side *six* being thrown may be a loading of the die, or an ability in the thrower to cause what side he pleases to turn up, either of which would be a common cause, acting through the several throws, and having a special relation to the side six.

The proportionate number of times which an event will occur in a great number of times is called by Laplace its *facility*, which word may be defined as follows: —

If a constant system of causes is combined within an infinite succession of *independent* causes; and if, of the infinite number of effects thus produced, a certain proportion belong to a class A, then is the *facility* of production of an effect of that class represented by the fraction representing the above-mentioned proportion. Or, we might say that the constant system of causes is combined with every possible independent cause, and represents the facility by the fraction expressing the ratio of the effects of the class A to the whole number of effects.

We easily see that the facility of an event depends on the constant causes alone. It is therefore the probability of the event to a mind acquainted with all the constant causes, or with the laws of their action.

Owing to the complicated manner in which the constant and the variable or independent causes are combined, and the general vagueness and difficulty of definition of the former, we can seldom determine with accuracy the facility of an event, except in a few simple mathematical cases. Thus, if we wish to construct a perfect table of mortality, if we select our lives from individuals of nearly the same place and time, the examples will not be sufficiently numerous to assure us that the independent causes have acted in every possible way; and if we select them from many countries, and during a long course of time, the circumstances of climate, general external condition, &c., which ought to be constant, will differ with the different individuals.

A few examples may serve to elucidate the above principles.

A bag contains black and white balls in an unknown ratio. The *probability* of drawing a white ball will be one half. But the *facility* will be represented by the ratio of the white balls to the whole number, supposing them to be mixed indiscriminately, and when this ratio is known, it will also be the probability.

So long as the deaths of individuals in any particular country all proceed from independent causes, we expect their number to agree with those deduced from a table of mortality, within certain limits of error. If, however, the country were ravaged by an epidemic, or any change were to take place in its climate, we should no longer expect the deaths to follow the laws of the tables of mortality. Here, however, would be a *single cause*, producing, or effecting in some way, the deaths of a number of individuals.

The neglect of the distinction between probability and facility has never led to any error, (except, perhaps, of interpretation,) because every answer to a question in chances must represent a *probability*. If we are ignorant of any of the constant causes, we can only deduce *the most probable value of the facility*, which may not be the real value; — if we know the law of action of all the constant causes, the probability and facility are the same.

Let us now consider a question which has been the subject of some dispute, viz. the nature of the argument by which, from the fact of the near approach of several stars, it is deduced that their proximity is not the result of chance. Writers on probabilities have generally agreed that such proximity indicates a physical connection between the stars.

The real argument for the connection is to be expressed in the following form: —

1. If the causes which fixed the position of each star were entirely independent of those which fixed the position of every other; or, in other words, if the stars were scattered by chance, it is *exceedingly improbable* that these (two, three, or seven) stars should be found as near each other as they actually are.

2. It is *not* very improbable that such proximity should result from the existence of a common element in the causes which determined their positions.

3. Therefore, such proximity being an ascertained fact, it is in the highest degree probable that it resulted from the existence of a common element, etc.

This reasoning is logically perfect. The first premise (if I may be allowed to call it so) is proved mathematically; the second is considered evident, and has seldom or never been expressed by writers on the subject, and the conclusion follows from the obvious principle, that, when compelled to adopt one of two possible suppositions, we select the most probable one.

The most elaborate argument in favor of the first premise is that given by Mr. Michell in the Philosophical Transactions for 1767. Professor J. D. Forbes of Edinburgh has taken some exceptions to Michell's methods, and to the general logical accuracy of his method of treatment, besides pointing out one of two mathematical errors in his computations,* in an article in the Philosophical Magazine for December, 1850. He raises the following objections: —

"First Objection. — *The doubt existing in the mind of a reasonable person whether an event still future, and which may happen many ways, shall occur in a particular given way, is erroneously considered as equivalent to an inherent improbability of its happening or having happened in that way.*"

Second Objection. — *To assume that every star is as likely*, not hypothetically, but actually, *to be in one situation as another, leads to conclusions obviously at variance with the idea of random or lawless distribution, and is therefore not the expression of that idea.*

He also negatives the following conclusions, which he conceives must be maintained by Michell's followers: — 1. That there is any *calculable* probability, such as 9570 to 1, against the observed occurrence of two stars out of more than 1000 within 4″ of one another having been fortuitous. 2. That the fact of two stars being seen within an infinitely small distance of each other amounts to a mathematical proof of the *certainty* of their being physically connected. 3. That were the stars uniformly spaced over the heavens, or arranged with perfect symmetry, no argument could be alleged against such arrangement being the result of chance, but any deviation from symmetry would raise such an argument.

With regard to the first objection it may be remarked, that, except the word *inherent*, what Professor Forbes objects to is equivalent to the very *mathematical definition* of the word *probability*. It seems likely that he uses the word in that sentence to express the idea or entity

* Neither of these errors affects the *general character* of the result.

which I have called *facility;* if so, the objection is well taken *against the general principle.* It does not, however, affect Michell's *result.*

The second objection is also aimed at what seems to me not only a mathematical, but a common-sense definition. If I correctly understand it, Professor Forbes attempts to sustain it by showing that it follows from the assumption alluded to in his objection, that a *uniform distribution* of the stars is that which would be most probable as the result of random scattering. This is true, but the *most probable* result of a trial may be *almost infinitely improbable.* We shall consider this more fully hereafter.

In the first conclusion denied by Professor Forbes, it is not made clear whether is meant (1.) the *a priori* probability that such an event *would occur* as the result of chance; or (2.) the *a posteriori* probability that, having occurred, it was the result of chance; or between the first and third propositions in the method of reasoning cited above. Let p be the *a priori* probability of the first proposition, l the *a priori* probability that the resulting proposition would result from some law, or of the second proposition. Then by the fundamental theorem of the probabilities of causes, the probability that the observed contiguity is the result of law is $\frac{l}{p+l}$, and the probability that it is the result of chance is $\frac{p}{l+p}$. Now, as above remarked, it is tacitly assumed by nearly all writers, that l, though a small fraction, is *very great* compared with p. Now p is, *to a certain extent,* capable of being expressed in exact numbers, but l is not; therefore $\frac{p}{l+p}$ is not. Professor Forbes is therefore correct if he refers to the second of the above meanings, as was remarked by Professor Boole in a subsequent number of the Philosophical Journal. At the same time, however, we may, by the aid of numerical calculation, make an *approximate* estimate of the probability of the proposition used in its second meaning.

The second proposition is a *demonstrable mathematical* certainty, *unless* it be held that it is *infinitely improbable* that two stars should be *infinitely near* as the result of law, which I apprehend no one will maintain. In fact, p will become infinitely small, while l remains finite, so that $\frac{p}{l+p}$ will become infinitely small.

The third proposition does not follow at all from Michell's argument. A certain calculable amount of irregularity, or grouping, is to be expected as the result of a random distribution. If the amount of grouping is much greater than this, it indicates that the components of each group were together in consequence of some common cause determining them to nearly the same position. *Vice versa*, if the stars are equally spaced over the heavens, it would indicate that some *constant cause* had operated, tending to *prevent them from occupying positions near each other.* Law and chance are not necessarily the antithesis of each other in the mathematical expression of their effects. Law is indicated by a deviation from what ought to be the results of chance, in whatever direction this deviation may be.

Let us in this connection return to the second objection of Professor Forbes, to see in what sense a uniform distribution is the most probable result of chance. It is so only when, supposing the heavens to be divided into a given number of equal spaces, we are required to specify exactly how many stars each *special division* contains. Suppose the heavens to be divided into 100 portions, and 200 stars to be distributed at random; then, if a person is required to guess how many stars the first space contains, how many the second contains, and so on to the hundredth, he ought to guess two for each space. Yet the chances are *millions to one* against the correctness of such a guess; but they would be *still greater* were he to guess differently. But suppose he were simply required to guess *how many spaces* contained no stars, how many contained one, &c., *without specifying the particular spaces* which contained the several numbers. Theory shows that, in the case supposed, the probability that a space selected at random contains n stars is very nearly $\frac{2^n}{n!\,e^2}$, e being the Neperian base. The individual ought, therefore, to guess that 14 spaces were devoid of stars,

27	spaces	contained	1 star	each,
27	"	"	2	"
18	"	"	3	"
9	"	"	4	"
4	"	"	5	"
1	"	"	6 stars.	

This guess, however, would include a number of guesses of the first class, equal to the number of possible permutations of 100 things, 14 of which were of one class, 27 of another, &c., to express which number would require *ninety-seven significant figures.* Yet the guess would in all probability be wrong in some respects, although there is no reasonable probability that it would differ *much* from the truth.

As another illustration, suppose that a die, of which four sides are white, is thrown thirty times. If the die is fair, white every time is evidently more probable than any other system of throws, supposing that in specifying the system we state *what color is thrown on each specific trial.* Yet such a result would prove beyond all reasonable doubt that the die was not fair. This statement will not appear paradoxical, if we consider that a constant series of throws of one color would *not* be very improbable on the supposition that the die was loaded, while they would be very improbable on the supposition that the die was fair. We therefore select the most probable series of circumstances, and say that the die is not fair. If an indiscriminate series of white and black throws result, the former being about twice as numerous as the latter, such result, describing what color was thrown on each throw, would be still more improbable than a constant series of whites on the supposition that the die was fair. But the former result would be *billions of times* less probable than the latter on the supposition that the die was loaded; so that, if the former result occur, we select the supposition of a fair die as the more probable.

It will be perceived that the *degree of speciality* with which a phenomenon is described affects very materially its *a priori* probability, but the full development of the results of this fact is reserved for a paper on the applications of the theory of probabilities to natural phenomena. I may remark, however, that much confusion has arisen from confounding the different degrees of probability which a proposition will have when expressed in the different forms,

A is X,
A is V,
A is Z, &c.,

when all V is X, all Z is V, &c., but V is an exceeding small portion of X, Z of V, &c. In such a case the *a priori* probabilities of the successive propositions will diminish with great rapidity. If, in the case of the above-mentioned die, supposed fair, one were to guess that the 2d, 5th, 8th, &c. throws would be black, and all the rest white, he would be 1024 times more likely to be wrong than if he guessed that they would all be white. But if he guessed simply that twenty throws would be white, and ten black, which guess would include the former, he would be myriads of times more likely to be right than if he guessed that they would all be white.

Professor Peirce made a communication upon the grounds of the probability of intermercurial planets, and upon polar forces.

Professor Agassiz gave an account of his recent investigations of the structure of the Radiata, and discussed their general homologies in reference to the natural limits of that branch of the animal kingdom. He proceeded to a comparison of their special homologies, and concluded that the Radiata embrace only three distinct classes, the Polyps, the Acalephs, and the Echinoderms; that the Hydroids are genuine Acalephs, as well as the Ctenophoræ, and that the Siphunculoids must be excluded from the type of Radiata.

An oral communication was received from a delegation from a committee of citizens engaged in promoting the contemplated expedition of Dr. Hayes to the Arctic regions, and the influence and good offices of the individual members of the Academy were solicited in its favor.

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