THE AMERICAN JOURNAL OF SCIENCE AND ARTS.

CONDUCTED BY

PROFESSOR SILLIMAN

AND

BENJAMIN SILLIMAN, Jr.

VOL. XL.—~~APRIL~~, 1841. 1840

(TO BE CONTINUED QUARTERLY.)

NEW HAVEN:

Sold by A. H. MALTBY and B. & W. NOYES.—*Philadelphia*, CAREY & HART and J. S. LITTELL.—*Baltimore, Md.*, N. HICKMAN.—*New York*, CARVILL & Co., No. 108 Broadway, THEODORE FOSTER, Fulton St., and G. S. SILLIMAN, No. 44 William St.—*Boston*, C. C. LITTLE & Co.—*London* and *New York*, WILEY & PUTNAM, No. 35 Paternoster Row, *London* and 161 Broadway, *New York*.—*Paris*, HECTOR BOSSANGE & Co., No. 11, Quay Voltaire.—*Hamburgh*, Messrs. NESTLER & MELLE.

PRINTED BY B. L. HAMLEN.

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ERRATUM.

P. 105, lines 26, 27. The phrases "*one of the outer bands,*" and "*the middle band,*" are to be substituted for each other.

ERRATA, VOL. XL.

P. 388, l. 5, dele *of the hyoid bone;* l. 22, for *edentata* read *edentula;* l. 23, for *namycush* read *namocush.* P. 389, l. 23, for *Ergrinum* read *Erysinum.*

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Notices of European Herbaria, particularly those most interesting to the North American Botanist.**

The vegetable productions of North America, in common with those of most other parts of the world, have generally been first described by European botanists, either from the collections of travellers, or from specimens communicated by residents of the country, who, induced by an enlightened curiosity, the love of flowers, or in some instances, by no inconsiderable scientific acquirements, have thus sought to contribute, according to their opportunities, to the promotion of botanical knowledge. From the great increase in the number of known plants, it very frequently happens that the brief descriptions, and even the figures, of older authors are found quite insufficient for the satisfactory determination of the particular species they had in view; and hence it becomes necessary to refer to the herbaria where the original specimens are preserved. In this respect, the collections of the early authors possess an importance far exceeding their intrinsic value, since they are seldom large, and the specimens often imperfect.

With the introduction of the Linnæan nomenclature, a rule absolutely essential to the perpetuation of its advantages was also established, viz. that the name under which a genus or species is first published shall be retained, except in certain cases of obvious and paramount necessity. An accurate determination of the Linnæan species is therefore of the first importance; and this, in numerous instances, is only to be attained with certainty by the inspection of the herbaria of Linnæus and those authors

* Communicated for this Journal by the author.

upon whose descriptive phrases or figures he established many of his species. Our brief notices will therefore naturally commence with the herbarium of the immortal Linnæus, the father of that system of nomenclature to which botany, no less than natural history in general, is so greatly indebted.

This collection, it is well known, after the death of the younger Linnæus, found its way to England, from whence it is not probable that it will ever be removed. The late Sir James Edward Smith, then a young medical student, and a botanist of much promise, was one morning informed by Sir Joseph Banks that the heirs of the younger Linnæus had just offered him the herbarium with the other collections and library of the father, for the sum of 1000 guineas. Sir Joseph Banks not being disposed to make the purchase, recommended it to Mr. Smith; the latter, it appears, immediately decided to risk the expectation of a moderate independence, and to secure, if possible, these treasures for himself and his country; and before the day closed had actually written to Upsal, desiring a full catalogue of the collection, and offering to become the purchaser at the price fixed, in case it answered his expectations.* His success, as soon appeared, was entirely owing to his promptitude, for other and very pressing applications were almost immediately made for the collection, but the upright Dr. Acrel having given Mr. Smith the refusal, declined to entertain any other proposals while this negotiation was pending. The purchase was finally made for 900 guineas, excluding the separate herbarium of the younger Linnæus, collected before his father's death, and said to contain nothing that did not also exist in the original herbarium: this was assigned to Baron

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* The next day Mr. Smith wrote as follows to his father, informing him of the step he had taken, and entreating his assistance.

"*Honored Sir:* You may have heard that the young Linnæus is lately dead: his father's collections and library, and his own, are now to be sold; the whole consists of an immense hortus siccus, with duplicates, insects, shells, corals, materia medica, fossils, a very fine library, all the unpublished manuscripts; in short, every thing they were possessed of relating to natural history and physic: the whole has just been offered to Sir Joseph Banks for 1000 guineas, and he has declined buying it. The offer was made to him by my friend Dr. Engelhart, at the desire of a Dr. Acrel of Upsal, who has charge of the collection. Now, I am so ambitious as to wish to possess this treasure, with a view to settle as a physician in London, and read lectures on natural history. Sir Joseph Banks, and all my friends to whom I have entrusted my intention, approve of it highly. I have written to Dr. Acrel, to whom Dr. Engelhart has recommended me, for particulars and the *refusal*, telling him if it was what I expected, I would give him a very

Alstrœmer, in satisfaction of a small debt. The ship which conveyed these treasures to London had scarcely sailed, when the king of Sweden, who had been absent in France, returned home and despatched, it is said, an armed vessel in pursuit. This story, though mentioned in the Memoir and Correspondence of Sir J. E. Smith, and generally received, has, we believe, been recently controverted. However this may be, no doubt the king and the men of science in Sweden were greatly offended, as indeed they had reason to be, at the conduct of the executors, in allowing these collections to leave the country; but the disgrace should perhaps more justly fall upon the Swedish government itself and the University of Upsal, which derived its reputation almost entirely from the name of Linnæus. It was however fortunate for science that they were transferred from such a remote situation to the commercial metropolis of the world, where they are certainly more generally accessible. The late Professor Schultes, in a very amusing journal of a botanical visit to England in the year 1824, laments indeed that they have fallen to the lot of the "*toto disjunctos orbe Britannos;*" yet a journey even from Landshut to London may perhaps be more readily performed than to Upsal.

After the death of Sir James Edward Smith the herbarium and and other collections, and library of Linnæus, as well as his own, were purchased by the Linnæan Society. The herbarium still occupies the cases which contained it at Upsal, and is scrupulously preserved in its original state, except that, for more effectual protection from the black and penetrating dust of London, it is divided into parcels of convenient size, which are closely wrapped in covers of strong paper lined with muslin. The genera

good price for it. I hope, my dear sir, you and my good mother will look on this scheme in as favorable a light as my friends here do. There is no time to be lost, for the affair is now talked of in all companies, and a number of people wish to be purchasers. The Empress of Russia is said to have thoughts of it. The manuscripts, letters, &c. must be invaluable, and there is, no doubt, a complete collection of all the inaugural dissertations which have been published at Upsal, a small part of which has been republished under the title of *Amœnitates Academicæ;* a very celebrated and scarce work. All these dissertations were written by Linnæus, and must be of prodigious value. In short, the more I think of this affair the more sanguine I am, and earnestly hope for your concurrence. I wish I could have one half hour's conversation with you; but that is impossible."—*Correspondence of Sir James Edward Smith, edited by Lady Smith,* Vol. I, p. 93.

The appeal to his father was not in vain; and, did our limits allow, we should be glad to copy, from the work above cited, the entire correspondence upon this subject.

and covers are numbered to correspond with a complete manuscript catalogue, and the collection, which is by no means large in comparison with modern herbaria, may be consulted with great facility.

In the negotiation with Smith, Dr. Acrel stated the number of species at 8000, which probably is not too low an estimate. The specimens, which are mostly small, but in excellent preservation, are attached to half-sheets of very ordinary paper, of the foolscap size,* (which is now considered too small,) and those of each genus covered by a double sheet, in the ordinary manner. The names are usually written upon the sheet itself, with a mark or abbreviation to indicate the source from which the specimen was derived. Thus those from the Upsal garden are marked *H. U.*, those given by Kalm, *K.*, those received from Gronovius, *Gron.*, &c. The labels are all in the handwriting of Linnæus himself, except a few later ones by the son, and occasional notes by Smith, which are readily distinguished, and indeed are usually designated by his initials. By far the greater part of the North American plants which are found in the Linnæan herbarium were received from Kalm, or raised from seeds collected by him. Under the patronage of the Swedish government, this enterprising pupil of Linnæus remained three years in this country, travelling throughout New York, New Jersey, Pennsylvania and Lower Canada: hence his plants are almost exclusively those of the Northern States.†

Governor Colden, to whom Kalm brought letters of introduction from Linnæus, was then well known as a botanist, by his correspondence with Peter Collinson and Gronovius, and also by his account of the plants growing around Coldenham, New York,

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* Upon this subject Dr. Acrel, giving an account of the Linnæan collections, thus writes to Smith. "Ut vero vir illustrissimus, dum vixit, nihil ad ostentationem habuit, omnia vero sua in usum accommodata; ita etiam in hoc herbario, quod per XL. annos sedulo collegit, frustra quæsiveris papyri insignia ornamenta, margines inauratas, et cet. quæ ostentationis gratia in omnibus fere herbariis nunc vulgaria sunt."

† Ex his Kalmium, naturæ eximium scrutatorem, itinere suo per Pennsylvaniam, Novum Eboracum, et Canadam, regiones Americæ ad septentrionem vergentes, trium annorum decursu dextre confecto, in patriam inde nuper reducem læti recipimus: ingentem enim ab istis terras reportavit thesaurum non conchyliorum solum, insectorum, et amphibiorum, sed herbarum etiam diversi generis ac usus, quas, tam siccas quam vivas, allatis etiam seminibus eorum recentibus et incorruptis, adduxit.—*Linn. Amœn. Acad.* Vol. III, p. 4.

which was sent to the latter, who transmitted it to Linnæus for publication in the *Acta Upsalensia*. At an early period he attempted a direct correspondence with Linnæus, but the ship by which his specimens and notes were sent was plundered by pirates;* and in a letter sent by Kalm, on the return of the latter to Sweden, he informs Linnæus that this traveller had been such an industrious collector, as to leave him little hopes of being himself farther useful. It is not probable therefore that Linnæus received any plants from Colden, nor does his herbarium afford any such indication.† From Gronovius, Linnæus had received a very small number of Clayton's plants, previous to the publication of the *Species Plantarum;* but most of the species of the *Flora Virginica* were adopted or referred to other plants on the authority of the descriptions alone.

Linnæus had another American correspondent in Dr. John Mitchell,‡ who lived several years in Virginia, where he collected

* Vid. Letter of Linnæus to Haller, Sept. 24, 1746.

† The *Holosteum succulentum* of Linnæus (*Alsine foliis ellipticis carnosis* of Colden) is however marked in Linnæus's own copy of the *Species Plantarum* with the sign employed to designate the species he at that time possessed; but no corresponding specimen is to be found in his herbarium. This plant has long been a puzzle to American botanists; but it is clear from Colden's description that Dr. Torrey has correctly referred it, in his *Flora of the Northern and Middle States*, (1824,) to *Stellaria media*, the common Chickweed. Governor Colden's daughter seems fully to have deserved the praise which Collinson, Ellis, and others have bestowed upon her. The latter, in a letter to Linnæus, (April, 1758,) says: "Mr. Colden of New York has sent Dr. Fothergill a new plant, described by his daughter. It is called *Fibraurea*, gold-thread. It is a small creeping plant, growing on bogs; the roots are used in a decoction by the country people for sore mouths and sore throats. The root and leaves are very bitter, &c. I shall send you the characters as near as I can translate them." Then follows Miss Colden's detailed generic character, prepared in a manner which would not be discreditable to a botanist of the present day. It is a pity that Linnæus did not adopt the genus, with Miss Colden's name, which is better than Salisbury's *Coptis*. "This young lady merits your esteem, and does honor to your system. She has drawn and described 400 plants in your method: she uses only English terms. Her father has a plant called after him *Coldenia;* suppose you should call this [alluding to a new genus of which he added the characters] *Coldenella*, or any other name that might distinguish her among your genera."—*Ellis, letter to Linnæus, l. c.*

‡ To him the pretty *Mitchella repens* was dedicated. Dr. Mitchell had sent to Collinson, perhaps as early as in the year 1740, a paper in which thirty new genera of Virginian plants were proposed. This Collinson sent to Trew at Nuremberg, who published it in the *Ephemerides Acad. Naturæ Curiosorum* for 1748; but in the mean time most of the genera had been already published, with other names, by Linnæus or Gronovius. Among Mitchell's new genera was one which he called *Chamædaphne:* this Linnæus referred to *Lonicera*, but the elder (Bernard)

extensively; but the ship in which he returned to England having been taken by pirates, his own collections, as well as those of Governor Colden, were mostly destroyed. Linnæus however had previously received a few specimens, as, for instance, those on which *Proserpinaca*, *Polypremum*, *Galax*, and some other genera, were founded.

There were two other American botanists of this period, from whom Linnæus derived, either directly or indirectly, much information respecting the plants of this country, viz. John Bartram and Dr. Alexander Garden of Charleston, South Carolina. The former collected seeds and living plants for Peter Collinson during more than twenty years, and even at that early day extended his laborious researches from the frontiers of Canada to Southern Florida, and to the Mississippi. All his collections were sent to his patron Collinson,* until the death of that

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Jussieu, in a letter dated Feb. 19, 1751, having shown him that it was very distinct both from *Lonicera* and *Linnæa*, and in fact belonged to a different natural order, he afterwards named it *Mitchella*.

* Mr. Collinson kept up a correspondence with all the lovers of plants in this country, among whom were Governor Colden, Bartram, Mitchell, Clayton, and Dr. Garden, by whose means he procured the introduction of great numbers of North American plants into the English gardens. "Your system," he writes Linnæus, "I can tell you obtains much in America. Mr. Clayton, and Dr. Colden at Albany, on Hudson's River, in New York, are complete professors, as is Dr. Mitchell at Urbana, on Rapahanock River, in Virginia. It is he that has made many and great discoveries in the vegetable world."—"I am glad you have the correspondence of Dr. Colden and Mr. Bartram. They are both very indefatigable, ingenious men. Your system is much admired in North America." Again, "I have but lately heard from Mr. Colden. He is well, but, what is marvelous, his daughter is perhaps the first lady that has so perfectly studied your system. She deserves to be celebrated."—"In the second volume of Edinburgh Essays is published a Latin botanic dissertation by Miss Colden; perhaps the only lady that makes profession of the Linnæan system; of which you may be proud." From all this, botany appears to have flourished in the North American colonies. But Dr. Garden, about this time, writes thus to his friend Ellis: "Ever since I have been in Carolina, I have never been able to set my eye upon one who had barely a regard for botany. Indeed I have often wondered how there should be one place abounding with so many marks of the divine wisdom and power, and not one rational eye to contemplate them; or that there should be a country abounding with almost every sort of plant, and almost every species of the animal kind, and yet that it should not have pleased God to raise up one botanist. Strange indeed that this creature should be so rare!" But to return to Collinson, the most amusing portion of whose correspondence consists of his letters to Linnæus shortly after the publication of the *Species Plantarum*, in which (with all kindness and sincerity) he reproves the great Swedish naturalist for his innovations, employing the same arguments which a strenuous *Linnæan* might be supposed to advance

amiable and simple-hearted man, in 1768; and by him many seeds, living plants, and interesting observations, were communicated to Linnæus, but few if any dried specimens. Dr. Garden, who was a native of Scotland, resided at Charleston, South Carolina, from about 1745 to the commencement of the American Revolution, devoting all the time he could redeem from an extensive medical practice to the zealous pursuit of botany and zoology. His chief correspondent was Ellis at London, but through Ellis he commenced a correspondence with Linnæus; and to both he sent manuscript descriptions of new plants and animals, with many excellent critical observations. None of his specimens addressed to the latter reached their destination, the ships by which they were sent having been intercepted by French cruisers; and Linnæus complained that he was often unable to make out many of Dr. Garden's genera for want of the plants themselves. Ellis was sometimes more fortunate; but as he seems usually to have contented himself with the transmission of descriptions alone, we find no authentic specimens from Garden in the Linnæan herbarium.

We have now probably mentioned all the North American correspondents of Linnæus; for Dr. Kuhn, who appears only to have brought him living specimens of the plant which bears his name, and Catesby, who shortly before his death sent a few living plants which his friend Lawson had collected in Carolina, can scarcely be reckoned among the number.*

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against a botanist of these latter days. "I have had the pleasure," Collinson writes, "of reading your *Species Plantarum*, a very useful and laborious work. But, my dear friend, we that admire you are much concerned that you should perplex the delightful science of botany with changing names that have been well received, and adding new names quite unknown to us. Thus botany, which was a pleasant study, and attainable by most men, is now become, by alterations and new names, the study of a man's life, and none now but real professors can pretend to attain it. As I love you, I tell you our sentiments."—*Letter of April* 20, 1754. "You have begun by your *Species Plantarum;* but if you will be for ever making new names, and altering old and good ones, for such hard names that convey no idea of the plant, it will be impossible to attain to a perfect knowledge in the science of botany."—*Letter of April* 10*th*, 1755; *from Smith's Selection of the Correspondence of Linnæus, &c.*

* In a letter to Haller, dated Leyden, Jan. 23, 1738, Linnæus writes; "You would scarcely believe how many of the vegetable productions of Virginia are the same as our European ones. There are Alps in the country of New York, for the snow remains all summer long on the mountains there. I am now giving instructions to a medical student here, who is a native of that country, and will re-

The Linnæan Society also possesses the proper herbarium of its founder and first president, Sir James E. Smith, which is a beautiful collection, and in excellent preservation. The specimens are attached to fine and strong paper, after the method now common in England. In North American botany, the chief contributors are Menzies, for the plants of California and the North West Coast; and Muhlenberg, Bigelow, Torrey, and Boott, for those of the United States. Here also we find the cryptogamic collections of Acharius, containing the authentic specimens described in his works on the Lichens, and the magnificent East Indian herbarium of Wallich, presented some years since by the East India Company.

The collections preserved at the British Museum, are scarcely inferior in importance to the Linnæan herbarium itself, in aiding the determination of the species of Linnæus and other early authors. Here we meet with the authentic herbarium of the *Hortus Cliffortianus*, one of the earliest works of Linnæus, which comprises some plants that are not to be found in his own proper herbarium. Here also is the herbarium of Plukenet, which consists of a great number of small specimens crowded, without apparent order, upon the pages of a dozen large folio volumes. With due attention, the originals of many figures in the *Almagestum* and *Amaltheum Botanicum*, &c., may be recognized, and many Linnæan species thereby authenticated. The herbarium of Sloane, also, is not without interest to the North American botanist, since many plants described in the *Voyage to Jamaica, &c.*, and the *Catalogue of the plants of Jamaica*, were united by Linnæus, in almost every instance incorrectly, with species peculiar to the United States and Canada. But still more important is the herbarium of Clayton, from whose notes and specimens Gronovius edited the *Flora Virginica.** Many Linnæan species are founded on the plants here described, for which this herbarium is alone authentic; for Linnæus, as we have already remarked, possessed very few of Clayton's plants.

turn thither in the course of a year, that he may visit those mountains, and let me know whether the same alpine plants are found there as in Europe." Who can this American student have been? Kuhn did not visit Linnæus until more than fifteen years after the date of this letter.

* *Flora Virginica, exhibens plantas quas J. Clayton in Virginia collegit.* Ludg. Bat. 8vo. 1743.—Ed. 2. 4to. 1762. The first edition is cited in the Species Plantarum of Linnæus; the second, again, quotes the specific phrases of Linnæus.

The collection is nearly complete, but the specimens were not well prepared, and are therefore not always in perfect preservation. A collection of Catesby's plants exists also in the British Museum, but probably the larger portion remains at Oxford. There is besides, among the separate collections, a small but very interesting parcel selected by the elder Bartram, from his collections made in Georgia and Florida almost a century ago, and presented to Queen Charlotte, with a letter of touching simplicity. At the time this fasciculus was prepared, nearly all the plants it comprised were undescribed, and many were of entirely new genera; several, indeed, have only been published very recently, and a few are not yet recorded as natives of North America. Among the latter we may mention *Petiveria alliacea* and *Ximinea Americana*, which last has again recently been collected in the same region. This small parcel contains the *Elliottia*, Muhl., *Polypteris*, Nutt., *Baldwinia*, Nutt., *Macranthera*, Torr., *Glottidium*, *Mayaca*, *Chaptalia*, *Befaria*, *Eriogonum tomentosum*, *Polygonum polygamum*, Vent., *Gardoquia Hookeri*, Benth., *Satureia* (*Pycnothymus*) *rigida*, *Cliftonia*, *Hypericum aureum*, *Galactia Elliottii*, *Krameria lanceolata*, Torr., *Waldsteinia* (*Comaropsis*) *lobata*, Torr. & Gr., the *Dolichos? multiflorus*, Torr. & Gr., the *Chapmannia*, Torr. & Gr., *Psoralea Lupinellus*, and others of almost equal interest or rarity, which it is much to be regretted were not long ago made known from Bartram's discoveries.

The herbarium of Sir Joseph Banks, now in the British Museum, is probably the oldest one prepared in the manner commonly adopted in England, of which, therefore, it may serve as a specimen. The plants are glued fast to half-sheets of very thick and firm white paper of excellent quality, (similar to that employed for merchants' ledgers, &c.,) all carefully cut to the same size, which is usually 16½ inches by 10¾, and the name of the species is written on the lower right-hand corner. All the species of a genus, if they be few in number, or any convenient subdivision of a larger genus, are enclosed in a whole sheet of the same quality, and labelled at the lower left-hand corner. These parcels, properly arranged, are preserved in cases or closets, with folding doors made to shut as closely as possible, being laid horizontally into compartments just wide enough to receive them, and of any convenient depth. In the Banksian herbarium, the shelves are also made to draw out like a case of drawers. This method is unrivalled for elegance, and the facility with which the specimens may be found and inspected, which to a working botanist with a large collection, is a matter of the greatest consequence. The only objection is the expense, which becomes very considerable when paper worth at least ten dollars per ream is employed for the purpose, which is the case with the principal herbaria in England: but a cheaper paper, if it be only sufficiently thick and firm, will answer nearly as well. The Banksian herbarium contains authentic specimens of nearly all the plants of Aiton's *Hortus Kewensis*, in which many North American species were early established. It is hardly proper, indeed, that either the elder or younger Aiton should be quoted for these species, since the first edition was prepared by Solander, and the second revised by Dryander, as to vol. 1 and 2, and the remainder by Mr. Brown. Many American plants from the Physic garden at Chelsea, named by Miller, are here preserved, as also from the gardens of Collinson, Dr. Fothergill, (who was Bartram's correspondent after Collinson's death,) Dr. Pitcairne, &c. There are likewise many contributions of indigenous plants of the United States, from Bartram, Dr. Mitchell, Dr. Garden, Fraser, Marshall, and other early cultivators of botany in this country. The herbarium also comprises many plants from Labrador and Newfoundland, a portion of which were collected by Sir Joseph Banks himself; and in the plants of the northern and arctic regions it is enriched by the collections of Parry, Ross, and Dr. Richardson. Two sets of the plants collected by the venerable Menzies in Vancouver's voyage, are preserved at the British Museum, the one incorporated with the Banksian herbarium, the other forming a separate collection. Those of this country are from the North West Coast, the mouth of the Oregon river, and from California. Many of Pursh's species were described from specimens preserved in this herbarium, especially the Oregon plants of Menzies, and those of Bartram and others from the more southern United States, which Pursh had never visited, although he often adds the mark *v. v.* *(vidi vivam,)* to species which are only to be met with south of Virginia.

The herbarium of Walter still remains in the possession of the Fraser family, and in the same condition as when consulted by Pursh. It is a small collection, occupying a single large volume.

The specimens, which are commonly mere fragments, often serve to identify the species of the *Flora Caroliniana*, although they are not always labelled in accordance with that work.

The collections of Pursh, which served as the basis of his *Flora Americæ Septentrionalis*, are in the possession of Mr. Lambert, and form a part of his immense herbarium. These, with a few specimens brought by Lewis and Clark from Oregon and the Rocky Mountains, a set of Nuttall's collections on the Missouri, and also of Bradbury's, so far as they are extant, with a small number from Fraser, Lyon, &c., compose the most important portion of this herbarium, so far as North American botany is concerned. There is also a small Canadian collection made by Pursh, subsequently to the publication of his Flora, a considerable number of Menzies's plants, and other minor contributions. To the general botanist, probably the fine herbarium of Pallas, and the splendid collection of Ruiz and Pavon, (both acquired by Mr. Lambert at a great expense,) are of the highest interest; and they are by no means unimportant in their relations to North American botany, since the former comprises several species from the North West Coast, and numerous allied Siberian forms, while our Californian plants require, in some instances, to be compared with the Chilian and Peruvian plants of the latter.

Besides the herbaria already mentioned, there are two others in London of more recent formation, which possess the highest interest as well to the general as to the American botanist, viz. that of Prof. Lindley, and of Mr. Bentham. Both comprise very complete sets of the plants collected by Douglas in Oregon, California, and the Rocky Mountains, as well as those raised from seeds or bulbs, which he transmitted to England, of which a large portion have, from time to time, been published by these authors. Mr. Bentham's herbarium is, probably, the richest and most authentic collection in the world for *Labiatæ*, and is perhaps nearly unrivalled for *Leguminosæ*, *Scrophularineæ*, and the other tribes to which he has devoted especial attention: it is also particularly full and authentic in European plants. Prof. Lindley's herbarium, which is very complete in every department, is wholly unrivalled in Orchidaceous plants. The genus-covers are made of strong and smooth hardware paper, the names being written on a slip of white paper pasted on the lower corner. This is an excellent plan, as covers of white paper in the herbarium of an active botanist, are apt to be soiled by frequent use. The paper employed by Dr. Lindley is 18½ inches in length, and 11½ inches wide, which, as he has himself remarked, is rather larger than is necessary, and much too expensive for general use.

The herbarium of Sir Wm. J. Hooker, at Glasgow, is not only the largest and most valuable collection in the world, in the possession of a private individual, but it also comprises the richest collection of North American plants in Europe. Here we find nearly complete sets of the plants collected in the Arctic voyages of discovery, the overland journeys of Franklin to the polar sea, the collections of Drummond and Douglas in the Rocky Mountains, Oregon, and California, as well as those of Prof. Scouler, Mr. Tolmie, Dr. Gairdner, and numerous officers of the Hudson's Bay Company, from almost every part of the vast territory embraced in their operations, from one side of the continent to the other. By an active and prolonged correspondence with nearly all the botanists and lovers of plants in the United States and Canada, as well as by the collections of travellers, this herbarium is rendered unusually rich in the botany of this country; while Drummond's Texan collections, and many contributions from Mr. Nuttall and others, very fully represent the flora of our southern and western confines. That these valuable materials have not been buried, nor suffered to accumulate to no purpose or advantage to science, the pages of the *Flora Boreali-Americana*, the *Botanical Magazine*, the *Botanical Miscellany*, the *Journal of Botany*, the *Icones Plantarum*, and other works of this industrious botanist abundantly testify; and no single herbarium will afford the student of North American botany such extensive aid as that of Sir Wm. Hooker.

The herbarium of Dr. Arnott of Arlary, although more especially rich and authentic in East Indian plants, is also interesting to the North American botanist, as well for the plants of the *Botany of Capt. Beechey's Voyage*, &c., published by Hooker and himself, as the collections of Drummond and others, all of which have been carefully studied by this sagacious botanist.

The most important botanical collection in Paris, and indeed, perhaps the largest in the world, is that of the Royal Museum, at the *Jardin des Plantes* or *Jardin du Roi*. We cannot now devote even a passing notice to the garden and magnificent new conservatories of this noble institution, much less to the menagerie, the celebrated museum of zoology and anatomy, or the cabinet of mineralogy, geology, and fossil remains, which, newly arranged in a building recently erected for its reception, has just been thrown open to the public. The botanical collections occupy a portion of this new building. A large room on the first floor, handsomely fitted up with glass cases, contains the cabinet of fruits, seeds, sections of stems, and curious examples of vegetable structure from every part of the known world. Among them we find an interesting suite of specimens of the wood, and another comprising the fruits, or nuts, of nearly all the trees of this country; both collected and prepared by the younger Michaux. The herbaria now occupy a large room or hall, immediately over the former, perhaps 80 feet long and 30 feet wide above the galleries, and very conveniently lighted from the roof. Beneath the galleries are four or five small rooms on each side, lighted from the exterior, used as cabinets for study and for separate herbaria, and above them the same number of smaller rooms or closets, occupied by duplicate and unarranged collections. The cases which contain the herbaria occupy the walls of the large hall and of the side rooms. Their plan may serve as a specimen of that generally adopted in France. The shelves are divided into compartments in the usual manner; but instead of doors, the cabinet is closed by a curtain of thick and coarse brown linen, kept extended by a heavy bar attached to the bottom, which is counterpoised by concealed weights, and the curtain is raised or dropped by a pulley. Paper of a very ordinary quality is generally used, and the specimens are attached, either to half sheets or to double sheets, by slips of gummed paper, or by pins, or sometimes the specimen itself is glued to the paper. Genera or other divisions are separated by interposed sheets, having the name written on a projecting slip.

According to the excellent plan adopted in the arrangement of these collections, which is due to Desfontaines, three kinds of herbaria have been instituted, viz. 1. The general herbarium. 2. The herbaria of particular works or celebrated authors, which are kept distinct, the duplicates alone being distributed in the general collection. 3. Separate herbaria of different countries, which are composed of the duplicates taken from the general herbarium. To these, new accessions from different countries are added, which from time to time are assorted and examined, and those required for the general herbarium are removed to that collection. The ancient herbarium of Vaillant forms the basis of the general collection: the specimens, which are all labelled by his own hand, are in excellent preservation, and among them plants derived from Cornuti or Dr. Sarrasin, may occasionally be met with. This collection, augmented to many times its original extent, by the plants of Commerson, Dombey, Poiteau, Leschenault, &c., and by the duplicates from the special herbaria, probably contains at this time thirty or forty thousand species. Of the separate herbaria, the most interesting to us, is that made in this country by the elder Michaux, from whose specimens and notes the learned Richard prepared the *Flora Boreali-Americana.*

Michaux himself, although an excellent and industrious collector and observer, was by no means qualified for authorship; and it is to L. C. Richard that the sagacious observations, and the elegant, terse, and highly characteristic specific phrases of this work are entirely due. There is also the very complete Newfoundland collection of La Pylaie, comprising about 300 species, and a set of Berlandier's Texan and Mexican plants, as well as numerous herbaria less directly connected with North American botany, which we have not room to enumerate. Here, however, we do not find the herbaria of several authors, which we should have expected. That of Lamarck, for instance, is in the possession of Prof. Rœper at Rostock, on the shores of the Baltic; that of Poiret belongs to Moquin-Tandon of Toulouse; that of Bosc, to Prof. Moretti of Pavia; and the proper herbarium of the late Desfontaines, which, however, still remains at Paris, now forms a part of the very large and valuable collections of Mr. Webb. The herbarium of Mr. Webb, although of recent establishment, is only second to that of Baron Delessert; the two being far the largest private collections in France, and comprising not only many older herbaria, but also, as far as possible, full sets of the plants of recent collectors. The former contains many of Michaux's plants, (derived from the herbarium of Desfontaines,) a North American collection, sent by Nuttall to the late Mr. Mercier of Geneva, a full set of Drummond's collections in the United States and Texas, &c. The latter also comprises many plants of Michaux, derived from Ventenat's herbarium, complete sets of Drummond's collections, &c. But a more important, because original and perhaps complete, set of the plants of Michaux is found in the herbarium of the late Richard, now in the possession of his son, Prof. Achille Richard, which even contains a few species that do not exist in the herbarium at the Royal Museum. The herbarium of the celebrated Jussieu, a fine collection, which is scrupulously preserved in its original state, by his worthy son and successor, Prof. Adrien Jussieu, comprises many North American plants of the older collectors, of which several are authentic for species of Lamarck, Poiret, Cassini, &c.

The herbarium of De Candolle at Geneva, accumulated throughout the long and active career of this justly celebrated botanist, and enriched by a great number of correspondents, is surpassed by few others in size, and by none in importance. In order that it may remain as authentic as possible for his published works, especially the *Prodromus*, no subsequent accessions to families already published are admitted into the general herbarium, but these are arranged in a separate collection. The proper herbarium, therefore, accurately exhibits the materials employed in the preparation of the Prodromus, at least so far as these were in Prof. De Candolle's own possession. As almost twenty years have elapsed since the commencement of this herculean undertaking, the authentic herbarium is of course much less rich in the earlier than in the later orders. The Compositæ, to which seven years of unremitted labor have been devoted, form themselves an herbarium of no inconsiderable size. It is unnecessary to enumerate the contributors to this collection, (which indeed would form an extended list,) since the author, at least in the later volumes of the Prodromus, carefully indicates, as fully as the work permits, the sources whence his materials have been derived. The paper employed is of an ordinary kind, somewhat smaller than the English size, perhaps about fifteen inches by ten ; and the specimens are attached to half-sheets by loops or slips of paper fastened by pins, so that they may readily be detached, if necessary, for particular examination. Several specimens from different sources or localities, or exhibiting the different varieties of a species, are retained when practicable ; and each species has a separate cover, with a label affixed to the corner, containing the name and a reference to the volume and page of the Prodromus where it is described. The limits of genera, sections, tribes, &c. are marked by interposed sheets, with the name written on projecting slips. The parcels which occupy each compartment of the well-filled shelves, are protected by pieces of binder's board, and secured by a cord, which is the more necessary as the cases are not closed by doors or curtains.

The royal Bavarian herbarium at Munich, is chiefly valuable for its Brazilian plants, with which it has been enriched by the laborious and learned Martius. The North American botanist will, however, be interested in the herbarium of Schreber, which is here preserved, and comprises the authentic specimens described or figured in his work on the grasses, the American specimens mostly communicated by Muhlenberg. The *Graminæ* of this and the general herbarium, have been revised by Nees von Esenbeck, and still later by Trinius. It was here that the latter, who for many years had devoted himself to the exclusive study of this tribe of plants, and had nearly finished the examination of the chief herbaria of the continent, preparatory to the publication of a new Agrostographia, was suddenly struck with a paralysis, which has probably brought his scientific labors to a close.

The imperial herbarium at Vienna, under the superintendence of the accomplished Endlicher, assisted by Dr. Fenzl, is rapidly becoming one of the most valuable and extensive collections in Europe. The various herbaria of which it is composed, have recently been incorporated into one, which is prepared nearly after the English method. It however possesses few North American plants, except a collection made by Enslin, (a collector sent to this country by Prince Lichtenstein, from whom Pursh obtained many specimens from the Southern States,) and some recent contributions by Hooker, &c. There is also an imperfect set of the plants collected by Hænke, (a portion of which are from Oregon and California,) so far as they are yet published in the *Reliquæ Hænkeanæ* of Presl, in whose custody, as curator of the Bohemian museum at Prague, the original collection remains.

The herbarium of the late Prof. Sprengel, still remains in the possession of his son, Dr. Anthony Sprengel, at Halle, but is offered for sale. It comprises many North American plants, communicated by Muhlenberg and Torrey. The herbarium of Schkuhr was bequeathed to the university of Wittemberg, and at the union of this university with that of Halle, was transferred to the latter, where it remains under the care of Prof. Von Schlechtendal. It contains a large portion of the *Carices* described and figured in Schkuhr's work, and is therefore interesting to the lovers of that large and difficult genus. The American specimens were mostly derived from Willdenow, who obtained the greater portion from Muhlenberg.

The royal Prussian herbarium is deposited at Schöneberg, (a little village in the environs of Berlin,) opposite the royal botanic garden, and in the garden of the Horticultural Society. It occupies a very convenient building erected for its reception, and is under the superintendence of Dr. Klotzsch, a very zealous and promising botanist. It comprises three separate herbaria, viz. the general herbarium, the herbarium of Willdenow, and the Brazilian herbarium of Sello. The principal contributions of the plants of this country to the general herbarium, garden specimens excepted, consist of the collections of the late Mr. Beyrich, who died in Western Arkansas while accompanying Col. Dodge's dragoon expedition, and a collection of the plants of Missouri and Arkansas, by Dr. Engelmann, now of St. Louis; to which a fine selection of North American plants, recently presented by Sir William Hooker, has been added. The botanical collections made by Chamisso, who accompanied Romanzoff in his voyage round the world, also enrich this herbarium; many are from the coast of Russian America and from California; and they have mostly been published conjointly by the late Von Chamisso and Prof. Schlechtendal in the *Linnæa*, edited by the latter.

The late Prof. Willdenow enjoyed for many years the correspondence of Muhlenberg, from whom he received the greater part of his North American specimens, a considerable portion of which are authentic for the North American plants of his edition of the *Species Plantarum.* In addition to these, we find in his herbarium many of Michaux's plants, communicated by Desfontaines, several from the German collector, Kinn, and perhaps all the American species described by Willdenow from the Berlin garden. It also comprises a portion of the herbarium of Pallas, the Siberian plants of Stephen, and a tolerable set of Humboldt's plants. This herbarium is in good preservation, and is kept in perfect order and extreme neatness. As left by Willdenow, the specimens were loose in the covers, into which additional specimens had sometimes been thrown, and the labels often mixed, so that much caution is requisite to ascertain which are really authentic for the Willdenovian species. To prevent farther sources of error, and to secure the collection from injury, it was carefully revised by Prof. Schlechtendal, while under his management, and the specimens attached by slips of paper to single sheets, and all those that Willdenow had left under one cover, as the same species, are enclosed in a double sheet of neat blue paper. These covers are numbered continuously throughout the herbarium, and the individual sheets or specimens in each are also numbered, so that any plant may be referred to by quoting the number of the cover, and that of the sheet to which it is attached. The arrangement of the herbarium is unchanged, and it precisely accords with this author's edition of the Species Plantarum. Like the general herbarium, it is kept in neat portfolios, the back of which consists of three pieces of broad tape, which, passing through slits near each edge of the covers, are tied in front: by this arrangement their thickness may be varied at pleasure, which, though of no consequence in a stationary herbarium, is a great convenience in a growing collection. The portfolios are placed vertically on shelves protected by glass doors, and the contents of each are marked on a slip of paper fastened to the back. The herbaria occupy a suite of small rooms distinct from the working rooms, which are kept perfectly free from dust.

Another important herbarium at Berlin, is that of Prof. Kunth, which is scarcely inferior in extent to the royal collection at Schöneberg, but it is not rich or authentic in the plants of this country. It comprises the most extensive and authentic set of Humboldt's plants, and a considerable number of Michaux's, which were received from the younger Richard. As the new *Enumeratio Plantarum* of this industrious botanist proceeds, this herbarium will become still more important.

For a detailed account of the Russian botanical collections and collectors, we may refer to a historical sketch of the progress of botany in Russia, &c., by Mr. Bongard, the superintendent of the Imperial Academy's herbarium at St. Petersburgh, published in the *Recueil des Actes* of this institution for 1834. An English translation of this memoir is published in the first volume of Hooker's *Companion to the Botanical Magazine*. A. G.

Art. II.—*Fragments of Natural History;* by J. P. Kirtland, M. D., Prof. Theo. and Prac. Phys., Medical College of Ohio, Cincinnati.

"I write that which I have seen."—*Le Baum.*

No. II.—*Ornithology.*

The feathered tribes of our country have been so thoroughly investigated by Wilson, Bonaparte, Nuttall, Audubon and Townsend, that the young ornithologist can hardly expect to meet with a new species, unless it be some straggler or accidental visitor from other parts of the world. An ample field is however furnished him, in which he may successfully employ his talents. The habits of some of our most interesting birds are but very imperfectly understood. If we take for instance the migratory Sylvias, we can obtain but little more than their names and scientific characters from those authors—and in regard to their habits, less than we have been able to discover by our own observations.

On investigating this subject, it may perhaps be discovered that in some instances, errors have been imbibed and perpetuated by mistaking the accidental movements of an individual bird under unusual circumstances, for the common habits of the whole species.

The term of life of no one person is of sufficient duration to allow him to complete a full and perfect history, even of our American species, from his own researches and observations; such a work must be the production of the joint labor of several ages and many individuals. Many facts remain to be supplied before it can be successfully completed. The opportunities for observing the movements, and obtaining a correct history of the habits and characters of the more rare birds, are only occasional and fortuitous, and are as likely to fall in the way of one who knows not how to improve them, as of one who possesses the talent for correct observation that distinguishes the author of the "Birds of America."

It is not to be expected that the public generally will ever turn aside from their usual pursuits to make observations on matters relating to natural science. The energies of some idle gunner may perhaps be aroused sufficiently by the appearance of a new or rare bird to induce him to destroy its life; the carcass will be gazed upon with a momentary curiosity, and then cast under foot.

In every community there are however some individuals who have a natural taste for matters of this kind. If they would improve the opportunities as they occur for making themselves familiar with the rarer birds, and would communicate the results of their observations to the public through the medium of some suitable publication, any deficiency in the history of our American birds would soon be supplied.

Entertaining this view, I am induced to offer for the pages of the Journal of Science, the following extracts from my notes and memorandums, made during the last three years.

A flock of Bohemian wax-chatterers, (*Bombycilla garrula*,) consisting of fifty or sixty individuals, were frequently seen in a marsh at the old mouth of the Cuyahoga river, near the city of Cleveland, during the month of March of the present year. They were usually engaged in feeding on the pulps and seeds of the swamp-rose, and as they were mistaken by the sportsmen for the common cherry bird, (B. Carolinensis,) they were permitted to pursue their occupation without interruption.

I procured a fine specimen, which is preserved in my cabinet; another is in the cabinet of Prof. Ackley, of this city.

We believe this to be the first instance in which this bird has been taken within the United States, or has been known to visit us in any considerable numbers; though we learn from the appendix to Nuttall's Ornithology, and also from Peabody's Report on the Birds of Massachusetts, that "the younger Audubon once pursued an individual of this species in that state."

Nuttall says, "the wax-chatterer, hitherto, in America, seen only in the vicinity of Athabasca river, near the regions of the Rocky Mountains in the month of March, is of common occurrence as a passenger throughout the colder regions of the whole northern hemisphere. In spring and late in autumn, they visit northern Asia or Siberia, and eastern Europe in vast numbers, but elsewhere are only uncertain stragglers."

Their size, markings and habits, readily distinguish them from the cherry or cedar bird. Justice is by no means done to their colors and beauty of form, in the figure given of the species by Bonaparte in the third volume of his American Ornithology.

An hyperborean phalarope, (*Phalaropus hyperboreus*,) was shot on Lake Erie, near the pier of Cleveland harbor, last November, by a young man in my employment, while pursuing a wounded gull.

The phalarope was a young bird in its winter plumage. It is preserved in my cabinet.

Little could be learned of its habits. It was a solitary individual, and when first discovered was resting on the water, where it seemed to be as much at home as any of the gulls with which it was associating.

The yellow throated gray warbler, (*Sylvia pensilis*,) must be considered not a rare annual visitor, even to the northern parts of Ohio, though Mr. Audubon informs his readers that "they confine themselves to the southern states, seldom moving farther towards the middle district than North Carolina," and "do not ascend the Mississippi further than the Walnut Hills," and Mr. Nuttall says, that they "very rarely venture as far north as Pennsylvania." I have in my possession a specimen that I shot on the banks of the Mahoning river, in Trumbull county, on the 5th of May, 1839; and during the last week of April of the present year, I killed three near the Cuyahoga river, three miles from Lake Erie. Early in July I also saw an old one feeding her young on the banks of the Mahoning. They were two thirds of their full size, and were perched on a small bush over the water. A full grown individual was seen on the first of August on the shore of the Lake within the limits of this city.

In every instance in which I have met with them, they seemed to have a strong predilection to the vicinity of water, and were generally engaged in capturing insects.

The *Sylvia rara* is common in the woods about the banks of the Cuyahoga during the spring and summer. Its habits are accurately described by Mr. Audubon.

The same locality is a favorite resort and breeding place for the purple breasted grossbeak, (*Fringilla Ludoviciana*.)

A flock of unusual birds, which I suppose to be the willow wrens, (*Sylvia trochilus*,) was discovered in September, 1839, on the shore of the lake near this city. They made only a momentary stop, for on firing at one of their number as they were settling down upon a bunch of thistles, the remainder suddenly darted away over the lake and disappeared.

The characters of the specimen taken agree with the description of the willow wren. They are said to be far more common in Europe than in the United States.

The Florida Gallinule, (*Gallinula chloropus*,) is not described by ornithologists as a western bird. Mr. Audubon says, "none are to be seen in the western country." Bonaparte informs his readers that "in the middle and northern United States it appears to be quite accidental; for, although a few well authenticated instances are known of its having been seen and shot even as far north as Albany, in the State of New York, it has escaped the researches of Wilson, as well as my own."

Mr. Nuttall gives us to understand, that "in the middle and northern states it appears to be quite accidental."

Notwithstanding this weight of authority to the contrary, I am disposed to consider this bird as one of our annual visitors, and not as a mere accidental straggler in these parts.

I have the best authority for asserting that several pair reared their young in a marsh not more than a mile from this city, during the last summer, and I know of at least half a dozen specimens that were shot there during the last spring. Broods of the young have also been repeatedly seen during the summer.

A mature male and female were recently sent me from Fairport, in Geauga county, by the Hon. Ralph Granger, and I am assured by a gentleman that one has been taken alive in the vicinity of Buffalo, in the State of New York. Another was taken at Warren, in Trumbull county, two years since, and became so far domesticated as to run about the barn yard in company with the fowls during the summer, but at the approach of autumn suddenly disappeared.

The late Dr. Ward informed me that he had occasionally met with them in the vicinity of Roscoe, Coshocton county, and Dr. Sager assures me that they visit Michigan. I have repeatedly heard of them in other sections of the western states.

In their habits they are so retiring and secluded that they may escape the attention of even the most active and sagacious observer.

The buff-breasted sandpiper, (*Tringa rufescens,*) which seems to be a rare species in most parts of our country, was seen in the vicinity of this city in three different instances during the last autumn. I secured two specimens, one of which I presented to the New York Lyceum of Natural History; the other is retained in my own collection.

This bird was unknown to Wilson and Bonaparte, and also to Mr. Audubon, until he received a specimen from England. It seems to be extremely shy and wary in its habits; and when watched by a gunner, will skulk behind some little hillock or tufts of grass. The individuals seen by myself were on a sandy flat not immediately contiguous to the water. In one instance Dr. Terry met with it in the public highway near this city.

The dunlin, ox-bird or purre, (*Tringa alpina,*) visited us in large flocks during three or four weeks of last autumn, and it has again appeared in a few instances the present spring. I have specimens preserved both in the summer and winter plumage.

Mr. Audubon informs his readers that he has "never found one far inland."

The Cape May warbler, (*Sylvia maritima,*) visits the northern parts of Ohio in small numbers every spring. A solitary individual may be seen here and there, busily employed in catching insects about the cherry and apple trees at the time they put forth their blossoms.

According to Mr. Nuttall, it "has only been seen near the swamps of Cape May, in New Jersey, and near Philadelphia."

The chestnut sided warbler, (*Sylvia icterocephala,*) is not uncommon with us for a few days in spring, and in one instance I saw a pair in a cranberry marsh in Boardman, Trumbull county, on the first day of June. The male was warbling its soft notes from the top of a young maple, and the female skipping about the bushes below. I am convinced they were preparing for nesting in that vicinity. Its note is rather loud, but soft and pleasant to the ear. Mr. Audubon seems to have met with it only in one instance.

The bay breasted warbler, (*Sylvia castanea,*) is still more common with us in the spring, and in some seasons protracts its visit for two or three weeks. Its favorite resort is the tops of the highest beach trees at the time the buds are bursting into leaves.

The willet, (*Totanus semipalmatus*,) Mr. Audubon says, "are very seldom met with far inland," and "I have little doubt that those seen by Mr. Say on the banks of the Missouri, had accidentally visited that country."

This bird is a common visitor to the shores of Lake Erie, both in the spring and autumn. On the 3d of July, 1838, I shot an old specimen from a flock of more than twenty individuals that were in the habit of visiting the marsh in Ohio City, at the mouth of the Cuyahoga, for a number of days in succession.

The young birds appeared here on the first of July of the present year, and considerable numbers have been shot by the sportsmen.

A few years since, they remained here during the whole of the summer, and probably reared their young in the neighborhood. They are very abundant about some of the upper lakes.

The marbled goodwit, (*Limosa fedoa*,) occasionally visits the shores of Lake Erie and the Ohio river. The Hon. Mr. Granger has furnished me with a beautiful pair, killed near his residence at Fairport. Several young specimens were shot in this vicinity about the first of August of the present season. They were associating with a flock of long-billed curlews, (*Numenius longirostris.*)

The Hudson curlew, (*Numenius Hudsonicus*,) has been taken in a few instances in Ohio. I have a specimen in my cabinet that alighted in the garden of Mr. A. Hayden, of this city, and was shot by him three years since. Another was taken in the vicinity of Cincinnati.

The piping plover, (*Charadrius melodus*,) I have seen in two instances on the shore of Lake Erie, and have specimens in my cabinet both in their winter and summer plumage.

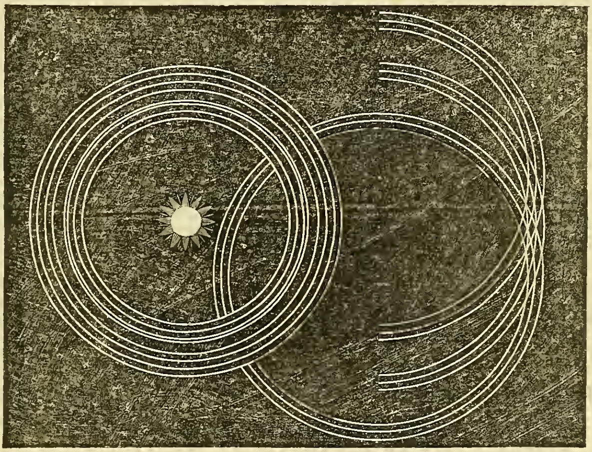
Mr. Audubon informs his readers that "they never proceed to any distance inland even along the sandy margins of our largest rivers."

Cleveland, Ohio, June 4, 1840.

Art. III.—*A Description of a Halo or Corona of great splendor, observed at Greensburgh, Westmoreland County, Pa.;* by Alfred T. King, M. D.

TO THE EDITORS.

Gentlemen—If you consider the subjoined description of one of those meteorological phenomena, usually denominated by philosophers coronas or halos, which was observed in this town about eleven o'clock, A. M. on the 28th of August last, and which excited considerable interest among the intelligent portion of the community, and apprehension and alarm in the minds of the uninformed, worthy of a place in your excellent Journal, it is much at your service.



This phenomenon consisted of from three to five circular belts or zones of light, one of which emulated, in appearance, the splendor and magnificence of the most gorgeous rainbow. The arrangement of these rings was somewhat singular; the first or inner one, which had the sun in its center, was *truly* brilliant, exhibiting all the prismatic hues of the rainbow, the colors of which were so dazzling that the unprotected eye could scarcely rest upon it a moment. This, I presume, was occasioned by the sun being near the meridian, and consequently many of his rays would impinge upon the halo, without passing through the mass of vapor, to the existence of which I attributed the formation of the halo. The outer circles, however, one only of which appeared to be perfect, were composed of pure white light, and had for their centres the circumference, or a point near it, of the inner ring. Consequently, their circumferences, if all the circles had been perfect, would necessarily have passed through the apparent situation of the sun. I mentioned, however, that one only of these rings was perfect, the others were concentric arcs of circles which crossed one another, as seen in the accompanying diagram.

In the centre of the inner circle and bounded by it, a bluish mass of dense vapor was perceptible, which gave to the whole an embossed appearance, and added much to the beauty and brilliancy of the scene. Around and within the exterior circles there were also perceptible masses of vapor, though obviously much less dense than the mass which was nearer the sun. With the exception of these masses of vapor, and a large *cumulus* which lay to the south of us, and here and there a few scattered *cirri*, the sky was cloudless and the atmosphere calm and serene. The mercury in the thermometer stood at 86°. The weather continued thus for thirty six hours, when we had a smart fall of rain, and a descent of the mercury in the thermometer to 36°, at which point or near this, it has remained until about three days since, when it rose to 66°.

Coronas and *parhelia* have frequently been observed and accurately and glowingly described, by many scientific gentlemen, and various and conflicting opinions have been entertained respecting their causes, some attributing them to the peculiar state of the air consequent upon intense cold, while others, probably more correctly, attribute them to the refraction and reflection of the rays of light through masses of vapor which are formed in such aggregations as are not heavy enough to fall in the form of drops. Descartes remarks, that halos never appear when it rains. Coronas have frequently been observed around the moon, and even around Sirius and Jupiter, but, as far as my information extends, they have been but seldom variegated, even when they have encircled the sun.

I know not to what cause this phenomenon can be attributed, unless it be to the refraction and reflection of the sun's rays through the masses of vapor. Doubtless the first circle was thus formed, and if we suppose the rays of light from the circumference of this circle to be again refracted and reflected through another mass of vapor, an outer ring would evidently result. Again, if we suppose the same to take place from another point of this circle, a second ring would be formed which would cross the other in some point of its circumference, and in like manner, I presume, any number of rings may be formed. I offer this explanation, however, with much diffidence.

Greensburgh, September 21, 1840.

Art. IV.—*Extracts from the Proceedings of the American Philosophical Society.**

Jan. 3, 1840.—Mr. Du Ponceau made a verbal communication respecting the publication of the Cochin Chinese Dictionary of the late Bishop of Adran, and also of a Latin and Cochin Chinese Dictionary by the Bishop of Isauropolis, and announced that the Grammar of the Berber language, by M. Venture, was about to be published.

Dr. Hare produced a remarkably beautiful specimen of potassium, in the globular form, assumed by falling into naphtha.

This specimen was a part of the product of one process which yielded him six ounces, two hundred and sixty three grains, avoirdupois.

The process and the apparatus by which this large amount of potassium was procured, had been described in the last volume of the Society's Transactions.

The quantity of materials employed, was 8 lbs. cream of tartar, reduced to 47 oz. by carbonization; and 3 oz. of coarsely powdered charcoal, from which the finer part had been sifted.

Notwithstanding the employment of a tube of two inches in diameter, it became choked with the potassium, carbon, and other volatile products, which were sublimed; and in the effort to open a passage, a steel rod, employed for this purpose, became so firmly fastened as to render its extrication impracticable by the force of two men.

In the effort to withdraw it, the tube was detached from the bottle. As the rod had been rendered smooth and cylindrical by the wire-drawing process, it could not have been thus held, upon any other view than that of its being soldered to the potassium.

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* It is our wish to present to our readers at least occasional notices of the proceedings of our scientific societies; and to make sure of some arrearages of the reports of the American Philosophical Society, (the parent society,) which have accumulated on our hands, we now present them as an article, although the materials properly belong to the miscellany—a course which we have sometimes taken in similar cases.—Eds.

The iron casing, used to protect the bottle, had been exposed to the fire during three processes; yet, excepting at the lower corner, it did not appear to be injured. With slight emendation, and with the protection of a stout disk of malleable iron, situate so as to form a basis, Dr. Hare had no doubt it might be used for several more operations.

In distilling the potassium from the tube, "per descensum," as described in his account of the process already referred to, the cap converging to a tapering tube was screwed on to that end of the receiver which was nearest the bottle; and, of course, this end was the lowermost in the distillatory process. This arrangement was preferable, as it prevented the loose deposition always found at the end of the tube farthest from the fire, from falling into the naphtha employed together with the potassium.

Agreeably to a provision of the by-laws, the list of surviving members of the Society was read. The number is 316; 216 of whom are residents of the United States, and 100 in foreign countries.

Feb. 6.—Mr. Saxton laid before the Society several copies of medals, produced by the galvanic process of Prof. Jacobi, of St. Petersburgh, and a small vase, obtained by a similar process, using a fusible metal matrix, which was removed when the form was obtained.

Mr. Lea exhibited nearly forty specimens of representations of plants and shells by the photographic process of Talbot, modified by Mr. Mungo Ponton, of Edinburgh. They were prepared by his son, Mr. Carey Lea, and were entirely successful; the minute parts of the plants and the outlines being perfect.

Feb. 21.—Mr. Lea read a paper, entitled "Description of Nineteen new Species of Colimacea," from his collection. These were recently received, and chiefly from Mr. W. W. Wood, now of Manilla.

Bulimus Woodianus,* Bulimus bicoloratus, Bulimus subglobosus, Bulimus gracilis, Bulimus carinatus, Bulimus virido-striatus, Bulimus Virgineus, Bulimus Liberianus, Cyclostoma Woodiana, Carocolla bifasciata, Helix cepoides, Helix Blainvilliana, Helix Lamarckiana, Helix luteo-fasciata, Helix ferruginea, Helix Cuvieriana, Helix Blandingiana, Helix Humphreysiana, Helix Balesteriana.

Dr. Hare described a mode of procuring silicon by an easy process. In the year 1833, Dr. Hare had published an engraving and description of an apparatus for evolving silicon or boron from their gaseous fluorides. In operating with the apparatus alluded to, a wire rendered incandescent by a calorimotor was made to ignite potassium while surrounded by fluosilicic or fluoboric acid gas. Consequently the potassium and fluorine entered into combination with phenomena of combustion, while the silicon was deposited or left in combination with potassium and its fluoride.

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* Want of room forces us to leave out the descriptions of these nineteen new species.

Lately he had resorted with success to a much simpler process, by which the evolution of silicon or boron might be made easy to any person possessing a sufficiently large mercurial reservoir.

A bell glass, over mercury, was filled with fluo-silicic acid, and by means of a bent wire, a cage of wire gauze, containing a suitable quantity of potassium, was introduced through the mercury into the cavity of the bell, and supported in a position nearly in the centre of it. A knob of iron was made at the end of the rod, so recurved as to reach the cage with ease. The knob, having been heated nearly white hot, was passed through the mercury so as to touch the cage, and cause the combustion of the potassium and evolution of the silicon. Of this, much remains attached to the cage, in combination with the fluoride of potassium, from which the silicon may be separated by washing in cold water and digestion in nitric acid.

Mr. S. C. Walker communicated an extract from a letter received from Mr. Edmund Blunt, detailing his observations of the Solar Eclipses of May 14th, 1836, and September 18th, 1838.

These were made at his private observatory, Brooklyn, New York. Latitude 40° 42′ 0″. Longitude 4h. 56m. 0s. nearly, west of Greenwich, being 4.36s. east of the City Hall, New York. They are given in mean time of the place of observation.

			h.	m.	s.	
Begin. Solar Eclipse,	May 14th, 1836,		19	10	1.30	E. Blunt.
End	"	"	21	40	31.20	"
Begin.	"	Sept. 18th, 1838,	3	17	18.80	"
Formation of Ring,		"	4	36	47.30	"
End of Eclipse		"	5	48	23.63	"
"	"	"	5	48	17.63	T. I. Page.

Mr. Blunt used a five feet Dollond's achromatic belonging to the Coast Survey. Mr. Page saw the end of the eclipse of 1836 with another telescope, within half a second of the time stated by Mr. Blunt. In the eclipse of 1838, the time noted for the formation of the ring was when the cusps were separated only by a few dark intervening spaces. Of these Mr. Blunt counted six in number. The instant of rupture of the ring was not noted. Mr. Blunt thinks that the luminous points connecting the cusps, continued twelve or fifteen seconds. Mr. Blunt did not see the dark lines described by Francis Baily, Esq. though favorably circumstanced for such an observation. Mr. Walker had found for the longitude of Mr. Blunt's observatory, from the beginning of the eclipse of 1836, 4h. 55m. 52.95s. and 4h. 56m. 2.07s. from the end :—Mean result, 4h. 55m. 57.51s. Mr. E. O. Kendall had found from the eclipse of 1838, a mean result of 4h. 56m. 1.16s. The mean, by the two eclipses, was 4h. 55m. 59.34s.; which makes the longitude of the City Hall, New

York, 4h. 56m. 3.7s. Mr. Paine, in the American Almanac, makes the same 4h. 56m. 4.5s.; and Mr. E. I. Dent, by transportation of four chronometers from the Greenwich observatory to New York, and again to Greenwich, finds for the same 4h. 56m. 4.42s. The mean of the three determinations is 4h. 56m. 4.2s.

March 6.—Mr. Saxton exhibited additional medals obtained by the galvanic process of Prof. Jacobi; and likewise pieces of charcoal and anthracite, which he had used as substitutes for the forms of fusible metal ordinarily employed. These were perfectly coated with copper, a fact which shows it to be but necessary, that the substance at the negative electrode should be a conductor of electricity.

March 20.—The committee, consisting of Prof. Henry, Dr. Patterson, and Mr. Walker, to whom was referred a paper entitled, "Observations of the Magnetic Intensity at twenty one Stations in Europe, by A. D. Bache, LL. D., President of the Girard College for Orphans, &c.," reported in favor of the publication of the paper in the Society's Transactions. The report was adopted, and the publication ordered accordingly.

The stations at which the observations recorded in this memoir were made, were twenty one in number: three in Great Britain, and the others on the continent of Europe. They include Edinburgh, Dublin, London, Brussels, Berlin, Paris, Vienna, the Flégière, Brientz, the Faulhorn, Geneva, Chamberi, Chamouni, Lyons, Milan, Venice, Trieste, Florence, Turin, Rome and Naples. The author remarks, that the magnetic dip and intensity are so well known at some of these places, that he produces his results for them in order that by comparison with those of other observers, the value of his determinations for other places may be judged of. The observations were of the horizontal intensity and dip, except in the comparison of the intensities at London and Paris, where, in addition, the statical method devised by Prof. Lloyd was used. At three of the stations the dip was not observed. The horizontal intensities were generally compared by oscillating two different needles in a rarefied medium, according to the method described by the author in a former paper, (Am. Philos. Society's Transactions, Vol. V.) At London and Paris two additional needles were employed. The dip was observed in the usual way, with an instrument by Robinson, by whom also the needles for Prof. Lloyd's method were made. The corrections required for temperature in the horizontal needles had been previously obtained. The correction for loss of magnetism by the needles, was ascertained from observations at Philadelphia, London, and Paris, and curves traced representing the loss, from which the specific correction, to be applied at any epoch, was readily obtained. The curve for one of the needles showed a tendency towards a permanent state, and for the other was nearly a straight line. Irregular changes took place in neither needle. The author's experience with these needles, induces him to give a preference to the method of placing the needles in pairs, over that which he has hitherto employed, of keeping each needle separate from the other. A suggestion also results in the use of the dipping needle, of the necessity of ascertaining that the needles have, in the reversal of the poles, been charged nearly, or quite, to saturation. The author takes occasion to correct his statement in regard to the inefficacy of heating needles in boiling water in producing an approach to a permanent magnetic state. The observations at each station, with the corrections employed, are given in tables; and the numbers observed for the dip, or calculated for the horizontal or total intensities, are compared with the results of other observers.

The memoir concludes with the following abstract of the numerical results.

No.	Places.	Latitude.	Long. from Paris.	Date.	Horizontal intensity.	Dip.	Total intensity.
		° ′	° ′		Paris = 1	° ′	Paris = 1
1	Edinburgh,	55 57 N.	5 32 W.	Feb. 3, 1837	0.841	— —*	——
2	Dublin,	53 23 "	8 41 "	Nov. 20, 1836	0.879	— —*	——
3	London,	51 31 "	2 26 "	June 16, 1837	0.939†	69 16.0	1.021
4	Brussels,	50 51 "	2 02 E.	July 25, 1838	0.969	— —*	——
5	Berlin,	52 32 "	11 02 "	Dec. 16, 1837	0.979	68 08.5	1.014
6	Paris,	48 50 "	0 00 "	Aug. 17, 1837	1.000	67 20.8	1.000
7	Vienna,	48 13 "	14 02 "	March 23, 1838	1.090	64 49.7	0.989
8	The Flégière,	— —	— —	Aug. 26, 1837	1.099	64 35.8	0.987
9	Brientz,	— —	— —	Sept. 22, 1837	1.078	65 06.7	0.987
10	The Faulhorn,	— —	— —	Sept. 20, 1837	1.082	65 01.7	0.987
11	Geneva,	46 12 "	3 49 "	Aug. 25, 1837	1.086	64 49.8	0.984
12	Chamberi,	— —	— —	June 21, 1838	1.089	64 35.0	0.979
13	Chamouni,	— —	— —	Aug. 26, 1837	1.088	64 38.2	0.979
14	Lyons,	45 46 "	2 29 "	June 25, 1838	1.078	64 49.0	0.978
15	Milan,	45 28 "	6 51 "	June 10, 1838	1.111	63 54.7	0.972
16	Venice,	45 26 "	10 10 "	April 11, 1838	1.129	63 21.9	0.971
17	Trieste,	45 38 "	11 27 "	April 4, 1838	1.128	63 20.5	0.970
18	Florence,	43 47 "	8 55 "	May 28, 1838	1.170	62 05.5	0.965
19	Turin,	45 04 "	5 20 "	June 17, 1838	1.094	63 52.2	0.959
20	Rome,	41 54 "	10 10 "	May 18, 1838	1.225	60 14.0	0.952
21	Naples,	40 52 "	11 57 "	May 7, 1838	1.249	59 05.1	0.938

The committee, consisting of Mr. Nicklin, Prof. Bache, and Dr. Hays, to whom was referred a paper, entitled "On the Patella Amæna of Say, by Isaac Lea," reported in favor of publication, which was ordered accordingly.

In this paper, Mr. Lea gives a synonymy, showing that the *Patella Amæna* of Say was first described by Müller, under the specific name of *Testudinalis:* Zool. Dan. p. 237; and Mr. Couthouy, having lately given an elaborate description of the animal in the Boston Journal of Natural Science, showing that it belongs to the new genus *Patelloida*, recently established by Quoy and Gaimard; Mr. Lea argues that it should henceforth be called *Patelloida Testudinalis.*

* Dip not observed.

† Mean of results in June, July and August, 1837, and in July and August, 1838.

Mr. Peale exhibited specimens of medals obtained by the process of Prof. Jacobi. He stated that Mr. Eckfeldt, of the Mint, had found the specific gravity of the copper thus procured, to be as high as that of rolled copper, that is, 8.95.

Mr. Peale also exhibited a diaphragm of parchment, which had been used in the battery employed in the process; and upon which metallic copper had been precipitated. He farther exhibited specimens of metallic silver, reduced, by a similar process, from the chloride of silver; but remarked, that it was not likely to lead to any useful analogous result, owing to the silver being deposited in a granular state.

April 3.—The committee, consisting of Dr. Patterson, Dr. Hare, and Prof. Bache, to whom was referred a paper entitled "On a new Principle in regard to the Power of Fluids in Motion to produce Rupture of the Vessels which contain them, and on the Distinction between Accumulative and Instantaneous Pressures; by Charles Bonnycastle, Professor of Mathematics in the University of Virginia," reported in favor of its publication in the Transactions of the Society, which was ordered accordingly.

Mr. Bonnycastle's investigation was suggested by a paper read by Dr. Hare, and printed in the Transactions of the Society, entitled "On the Collapse of a Reservoir, whilst apparently subject within to great Pressure from a Head of Water." Dr. Hare pointed out the circumstances attendant upon this curious occurrence, and showed how the vessel might have been momentarily relieved from the pressure of the water within, so as to make that of the surrounding air efficient in producing the collapse. The principal object of Mr. Bonnycastle's paper is to investigate the precise nature and degree of the forces brought into action in this and similar cases.

The results at which Mr. Bonnycastle arrived, are stated by him as follows:—

1. It is convenient to distinguish between accumulative and instantaneous loads, or between those which are gradually increased until the deflection due to the ultimate load is obtained, and those which commence in full efficacy from the initial position of the support.

2. Within the limits of perfect elasticity, instantaneous pressure produces twice the effect of that which is accumulative, whether the result be to produce deflection or fracture.

3. In regard to supports perfectly elastic in one direction, and perfectly flexible in the other, instantaneous action, at right angles to the axis of elasticity, produces a deflection which is to that of accumulative action as $\sqrt{4}$ to 1, whilst the tendencies to fracture are as 4 to 1. But should any case occur when the law of elasticity follows an extremely high power of the deflection, then the singular result will follow, that the deflections are the same, whether the force be exerted from the initial state or the

state of load, but that the tendency to fracture will be immensely greater in the former case than in the latter.

4. In producing the fracture of natural substances, which all depart from the law of perfect elasticity as we approach the limit of fracture, the ratio of the effect of instantaneous and accumulative action will vary with the nature of the substance, never being less, for elastic bodies, than 2 to 1, nor for flexible than 4 to 1, and more usually approaching 3 or 4 to 1 for the former case, and 5 or 6 to 1 for the latter.

5. Let a vase or conduit be acted upon by a load which is alone sufficient to break it, and let this load be partly balanced by a small exterior force: should the great interior force suddenly cease, the small exterior action may crush the vase or conduit inward; its energy in such case being the sum of the interior and exterior forces.

6. Should the interior force be a vibration of the kind already explained, and should the exterior action be extremely feeble, and act on a very great mass, this extremely feeble action may crush the vase inward, with a power that shall exceed in any degree the enormous action of the interior or explosive vibration. The comparison of the interior and exterior actions is best effected in this case, by finding the modulus of elasticity of a material spring that shall coincide most nearly in effect with the interior tremor. For putting e and e' respectively for the modulus of the spring and of the support, and σ and σ' for the deflections resulting from the tremor acting alone, and the reaction as it does act, we have $\frac{\sigma'}{\sigma} = \sqrt{\frac{e}{e'}}$, or, in other words, the deflection produced by the reaction, is to the deflection that would be produced by the interior tremor alone, in the inverse proportion of the square roots of the moduli of tremor and support.

7. Combining what is here said with the known laws of fluids moving in pipes, and whereby they necessarily produce hydraulic shocks, it follows, that any vessel connected with such a train of pipes, and plunged at some little depth in a considerable mass of water, or other heavy fluid, will occasionally be subject to a crushing and exterior force vastly greater than the interior strain due to the constant head of fluid.

In illustration of the principles thus developed, Mr. Bonnycastle details some experiments, and mentions a phenomenon which occurred under his own notice, and is analogous to the one described by Dr. Hare. In making experiments on the propagation of sound through water, he had occasion to cause an explosion of gunpowder within a hollow metallic cylinder, open at the lower end, and immersed under the liquid; and, although the strength of the cylinder was abundantly sufficient to bear the statical pressure of the surrounding water, he found it crushed inward after the explosion.

Judge Hopkinson deposited with the Society, the Log Book of the first voyage in a steam vessel across the Atlantic, by Captain Rogers, in the year 1819; an account of which was given in the Proceedings of the Society, No. 2, p. 14.

In a written communication, Judge Hopkinson stated, amongst other matters in reference to Captain Rogers's priority, that he was on board the steam-ship lying at the city of Washington, after her return from the voyage. She was built and rigged like one of the Liverpool packets, and her wheels were made to fold up at her sides when the wind permitted her sails to be used.

The Log Book states, among the occurrences usually noted, the days when the steam was used.

April 17.—The committee, consisting of Prof. Bache, Dr. Patterson and Mr. Walker, to whom was referred a paper entitled "On the Storm which was experienced throughout the United States about the 20th of December, 1836, by Elias Loomis, Professor of Mathematics and Natural Philosophy in Western Reserve College," reported in favor of publication in the Society's Transactions, which was ordered accordingly.*

The memoir of Prof. Loomis first describes the sources of information to which he has had access, consisting of various published or private meteorological journals. The principal phenomena occurred in the eastern states, within the period recommended by Sir John Herschel for hourly meteorological observations; and were, of course, accurately noted at the stations where these observations were made. From various sources, Prof. Loomis has obtained observations of the barometer at twenty seven different stations in the United States and the neighboring British possessions, and records of the thermometer and weather from twenty eight military stations of the United States, from forty two academies of the State of New York, and from five other stations within the probable limits of the storm, besides others beyond it. In some cases, two sets of observations were made at the same station.

The phenomena are discussed by the author under the following heads. 1. A remarkable oscillation of the barometer. 2. A sudden depression of the thermometer. 3. The amount, and the time of beginning and ending of the rain. 4. The direction and velocity of the wind.

1. The observations of the barometer show that during the storm there was a sudden depression of the barometer immediately succeeded by a sudden rise; that the minimum of pressure occurred first in the western states, and passed in a wave over the United States, moving eastwardly. The curves drawn to represent the heights of the barometer illustrate this fact in a very striking manner. Prof. Loomis has attempted to determine, from the observations, the amount of depression of the barometer, the

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* We are indebted to Prof. Loomis for a copy of his elaborate paper.—Eds.

form and velocity of the atmospheric wave, the progress of which, over the United States, he has represented upon a chart.

2. A comparison of the observations of the thermometer and barometer shows, that while the pressure was diminishing the temperature was increasing, and vice versa. The very remarkable diminution of temperature of 48° Fah. in six hours and a half, occurred at one station in the N. W. of the United States. The commencement of the diminution of temperature is shown to coincide with the minimum of the barometer, and hence is used when barometric observations were not made, to point out the probable time of the occurrence of this minimum. The average of the maxima of the thermometer at the eastern stations was about 3½° Fah. greater than at the western, and the average of the minima 14° Fah. greater.

3. Rain or snow fell during the storm within the limits of about latitude 28° N. to latitude 48° N., and from longitude 52° to 96° W. The average amount at fifty nine stations, was seven eighths of an inch. The author is led to remark upon the great discrepancies in the statements of the fall of rain at places very near each other, and upon defects in the registers in not stating the time of beginning and ending of the rain.

4. The epoch of the minimum of pressure at the several places of observation was marked by a change of wind from a southern quarter, generally the southeast, to a northern quarter, almost uniformly the northwest. This southern change of wind was every where one of the most prominent features of the storm, the wind having been violent both before and after the change; but more violent from the northwesterly direction, except perhaps at New York and in the northeastern states.

The author sums up thus the characteristic of the storm. After a cold and clear interval, with the barometer high, the wind commenced blowing from a southerly quarter; the barometer fell rapidly, the thermometer rose, and rain fell in abundance. The wind subsequently veered suddenly to the northwest, and blew with great violence; the rain was succeeded by hail or snow, which continued but for a short time. The changes thus described occurred, not simultaneously, over the United States, but progressively from west to east.

The author next endeavors to determine the limits of the storm, using for this purpose other meteorological registers in addition to those before noticed, and of which he gives a particular account. From these, and theoretical considerations, he places the Rocky Mountains as the western limit, the parallel of 25° N. latitude as the southern limit, the middle of the Atlantic as the eastern limit, and the northern as altogether conjectural, but probably as remote as the arctic circle, thus extending over 70° of longitude and 40° of latitude. The question whether the remarkable storm which occurred in Europe about the 25th of December, was a continuation of this storm, is examined, and the author concludes, from a discussion of its peculiarities, that it was not—the progress of the barometric minimum in Europe being from north to south, inclining a little to the west.

The author next proceeds to generalize the deductions in regard to the circumstances of this storm, and to apply them as tests to the different theories of wind, rain, &c.

He first endeavors to show how far registered observations of the wind may be influenced by localities, and their accuracy affected by the mode of observing, and the transcribing of the registers; and concludes that it is indispensable to regard the average of directions at near stations, and not those at individual ones, and gives some examples of discrepancies at places near each other in support of this opinion. The anomalies presented by the stations in the State of New York are very curious.

The causes assigned by theory for the production of winds are next enumerated and discussed. Recurring to the observations, the author traces a connection between the direction of the surface wind on the 18th and 19th of December, and a maximum of the barometer existing on a line nearly north and south, moving eastwardly, and passing on the morning of the 20th of December nearly through the eastern extremity of the State of Maine. At this period a minimum of the barometer existed nearly on the line of the river Mississippi, and the winds blew towards this line. This minimum is traced in its motion eastward; and in connection with it, the change of wind from the easterly to the westerly quarter. On the afternoon of the 21st, the line of minimum pressure had reached Boston; and on the 22d, the northwesterly wind now prevailed at nearly all the stations. The direction and approximate force of the wind on the morning of the 21st, are represented upon a map of the United States, accompanying the memoir. From an examination of a phenomenon of the wind, Prof. Loomis concludes that the southeasterly current rose, so that the northwesterly wind thus became the lowermost current; and subsequently, from an examination of the phenomenon of the rain, snow and hail, that the rising current was, in part at least, deflected back upon itself. The immediate cause of the southeasterly wind is traced to the existence of a minimum of pressure at some point north of the United States.

The author next examines the various causes which have been, or may be, in his opinion, assigned as producing rain, and infers that the most common cause of rain, in these latitudes, is the sudden lifting up of warm air into regions about the earth's surface, by its displacement by a cold current originally above it, and from an opposite direction; and that such was the actual cause of the rain in question, a warm current from the south having been displaced, and caused to rise to a considerable elevation by a cold current from the west. The mixture of the warm and cold air is inadequate, in the author's opinion, to account for the phenomena.

The author then explains the causes of the observed rise of the thermometer to be due to the warm southeast wind, and the subsequent depression to the cold northwest wind.

The author next examines the causes which have been assigned for the fluctuations of the barometer during this storm, selecting, as applicable to the present case, the following :—" The southeast wind, which accompanied the rain, moved with an accelerated velocity. The particles, therefore, of air at one extremity of the current, must have left those of the other extremity at an increased distance. Hence a mechanical rarefaction, and, of course, diminished pressure. The reverse effect must have taken place after the storm had passed. A northwest wind sets in with great violence. A vast body of air is precipitated toward the southeast. The partial vacuum which at first existed, is very soon supplied; yet, though the first impelling cause has ceased to act, the momentum of the excited current still urges it onward, and a condensation results, which continues the rise of the barometer."

The author concludes by remarking, that he has availed himself in these discussions of the suggestions of writers on meteorology, and is especially indebted to the labors of Messrs. Redfield, Espy and Reid.

Dr. Dunglison read a letter from the Rev. James T. Dickinson, of Singapore, to Mr. Du Ponceau, dated Nov. 25, 1839, expressing his satisfaction with the views of Mr. Du Ponceau, as contained in his "Dissertion on the Chinese system of Writing."

When Mr. Dickinson commenced the study of the Chinese language, nearly four years ago, he attempted to learn the written language by the eye merely, without connecting sounds with the characters. To this course he was led by the fact, that the Hokkien dialect, the one he studies, differs very much as *spoken,* from the sounds given to the characters as *read.* His plan was to learn the colloquial language by itself, and to defer the learning of the sounds given to the characters in reading, while, in the mean time, he endeavored to learn to read the characters independently of all sounds. In this way he would have succeeded in learning to read Chinese books, had the common hypothesis, that the Chinese characters are addressed *directly* to the mind, and not to the mind through the medium of sounds, been correct. Mr. Dickinson, however, found himself always translating either into English or the colloquial Chinese. All his efforts to transfer the ideas represented in Chinese books to his own mind, without the help of words, either Chinese or English, were fruitless.

Mr. Dickinson considers the work of Mr. Du Ponceau "a most valuable gift to the world, and an honor to American learning."

May 1.—The committee, consisting of Mr. Walker, Dr. Patterson, and Mr. Bache, to whom was referred a paper, entitled "Observations on Nebulæ, with a fourteen feet Reflector, by H. L. Smith and E. P. Mason, during the year 1839, by E. P. Mason," reported in favor of publication in the Society's Transactions, which was directed accordingly.

The object of Messrs. Smith and Mason was to furnish a minute description of some of the principal nebulæ in the heavens, in order that future changes in their appearance, should any occur, may be detected. The process employed was—1st. To prepare an accurate chart of all the stars in and about the nebula, capable of micrometrical measurement. 2dly. To fill in with the smaller stars down to the *minimum visibile*, by estimation. 3dly. To lay down the nebula on this chart with such care and precision, that the errors of its delineation may not far exceed those of original vision. The author, Mr. Mason, states at length the expedients used to effect the latter purpose, viz. the drawing of *lines of equal brightness*, as a guide to the engraver; the examination of each portion of the nebula by several persons; and lastly, the repeated comparison of the drawings with the original on successive evenings, till no further improvement seemed to be practicable.

The telescope used by Messrs. Smith and Mason, was of their own construction. It was fourteen feet in length, and had twelve inches clear aperture, being a Herschelian, mounted somewhat rudely on the plan of Mr. Ramage. The difficulties experienced by Messrs. Smith and Mason, as amateur artists, in casting and polishing specula at New Haven, are stated in detail. The telescope was capable of separating ζ Orionis, μ^2 Bootis, γ Virginis in 1838, λ Ophiuchi, and others of a distance of less than $1''$. For such purposes, however, the use of diaphragms was necessary, owing to an imperfection of the casting, and the full light of the telescope could not be employed. This circumstance directed their attention to the subject of this paper.

A cursory examination of the principal nebulæ described, and, in some instances, figured by the Herschels, pointed out discrepancies between their descriptions and present appearances, which must be attributed either to a change in the nebulæ themselves, or to the want of sufficient minuteness of examination on the part of the Herschels, whose object was rather the formation of a complete catalogue of the nebulæ in the heavens, than the full and perfect description of any of the individuals. Thus, the paper contains a drawing of the "nebula trifida," *h.* 1991: the triple star does not occupy the same position in the cleft as given in the figure in Sir J. F. W. Herschel's paper, Phil. Trans. 1833, but rather adheres to the left of the three divisions; and what is more remarkable, the small star about $30'$ north of this triple star was surrounded with a nebula not much inferior in size and brilliancy to the "*nebula trifida.*" A drawing is also furnished of the nebula, *h.* 2008, (the shape of which resembles the capital Greek Ω,) with a critical examination of Herschel's figure of the same.

The most remarkable discovery of Messrs. Smith and Mason, was that of the junction of the two nebulæ, *h.* 2092 and 2093. These great nebulæ, or "*milky ways*," are described on several occasions by the elder

Herschel, and are also described and figured by the younger. They are distant about two thirds of a degree from each other. Messrs. Smith and Mason, however, distinctly saw the nebulous matter extending from one to the other, making the whole one conspicuous nebula of more than a degree in length, being among the most remarkable in the heavens, and inferior only to the great nebulæ of Orion and Andromeda.

Mr. Mason remarks, that it is difficult to conceive how the companion of the *nebula trifida* and the junction of the two last mentioned, should have been overlooked by such observers as the Herschels, with instruments so far superior to his in optical capacity. The supposition that the nebulous space, noticed by Messrs. Smith and Mason, was not brought under the immediate inspection of the Herschels, seemed inadmissible. That the greater clearness of the atmosphere of New Haven should more than compensate for the inferior light of the telescope employed was hardly probable ; the only remaining supposition was, that the nebulous matter, in the space examined by all these observers, has recently undergone a change in shape and brilliancy.

In making the chart of the stars to which the nebulous space is referred, Mr. Mason used the ten feet Dollond refractor, of five inches aperture, belonging to the philosophical department of Yale College, with a Dollond's illuminated line micrometer. With this he has determined the relative position of the stars down to the sixteenth magnitude, by repeated observations, and has furnished a catalogue of the correct places of fifteen stars in the first chart, thirty in the second, and a hundred and eighty two in the third.

May 15.—Mr. Du Ponceau made a verbal communication on the subject of the silk culture in India.

It appears from the sixth volume of the Transactions of the Agricultural and Horticultural Society of India, Calcutta, 1839, which is in the library of the Society, that the English are extending the culture of silk to the Deccan and the western coast of India, and have an establishment for that purpose under the direction of Signor Mutti, an Italian gentleman, who resides at Bombay, and is styled "Superintendent of the Silk Culture in the Deccan." Two letters addressed by him to John Bell, Esq. Secretary of the Agricultural Society of India, Mr. Du Ponceau considered to be worthy of the attention of those who feel an interest in the promotion of the silk culture in this country. A treatise by that gentleman on the various branches of the silk culture, is subjoined to, and published with, his letters. The chapter or division concerning the art or method of reeling or winding silk from the cocoons, Mr. Du Ponceau regards as replete with valuable practical instruction.

On this last subject, (the art of reeling,) the correspondent at Paris of the National Intelligencer asserts, that an excellent treatise has been lately published in that capital by Mons. Ferrier, which has been republished in the third volume of the Annals of the *Sericole Society*, specially instituted for the promotion of the culture of silk in France.

As instruction is much wanted in this country on this particular subject, while the culture of silk engages the general attention, Mr. Du Ponceau expressed a hope that M. Ferrier's treatise would be translated and published for the benefit of his fellow citizens.

Mr. Du Ponceau further stated, that from the volume of Transactions above cited, it appears that the English are making great exertions to introduce the culture of cotton into India. Specimens of the best soils for growing cotton in this country, particularly those of Georgia, have been sent to the Agricultural and Horticultural Society, and analyzed by them. The descriptions accompanying the specimens have not been found sufficiently particular, nor have their analyses yet led to any decided conclusions. They seem to think, that the abundance and fineness of good cotton depend on the quantity of *carbon* in the soil, *and the solubility of that carbon.* But with this theory they do not appear to be entirely satisfied. They find that all the American, the Mauritius, and the best Singapore soils, producing the finest cotton, contain a considerable per centage of vegetable matter under the form of peat or lignite, in a state of exceedingly minute division, and in many of them, some part of it is readily soluble in cold water. They find, again, that the Indian soils contain very little vegetable matter, and this wholly insoluble in water, but that the best contain a far larger proportion of carbonate of lime, and some of them the iron in a different state from the others. It would seem, however, that the plant is somewhat indifferent about the iron; yet, as it is not known what part the iron plays in soils, (which may influence their electricity as well as their tenacity and relations to moisture,) they consider it a matter to be borne in mind and to be subjected to farther inquiries.

The culture of the vine in India, Mr. Du Ponceau added, appears also to engage much of the attention of the Society; and, on the whole, the useful arts and sciences seem to be cultivated in that country to a degree which deserves to be particularly noticed.

Mr. Walker stated the results of Prof. Loomis's farther observations on the subject of Galle's second comet, which Prof. L. intends hereafter to lay before the Society. He further stated, that Galle had discovered a third comet, which was of great interest to the astronomer, as it was likely to add another to the number of comets of known period.

Mr. Walker mentioned the receipt of European observations of Galle's second comet, as late as the 21st of February, and those of Prof. Loomis of the 18th and 19th of March. From these, he had selected the observations made January 25th and February 21st, at the Berlin Observatory, and that of Prof. Loomis at the Hudson Observatory, on the 19th of March, and had computed the elements of its orbit.

The comet's observed geocentric longitude and latitude, cleared of aberration and parallax, and referred to the mean equinox of January, 1840, were as follows :—

M. T. Berlin.	*Longitude.*			*Latitude.*		
25.^{d}49021	2°	57′	26.8″	+75°	9′	42.1″
52. 47442	28	44	0.6	+33	42	26.1
79. 59679	35	47	34.8	+ 9	22	20.4

From which he had obtained for the elements of the comet :—

Perihelion Pass. March 13.^{d}07523 Berlin mean time.

☊	236°	49′	8.0″
ι	59	15	8.9
π	80	14	52.8

log. q. 0.086798

Motion retrograde.

Dr. Dunglison gave the particulars of a case, in which blood that flowed on dissection from the arteries of the brain coagulated, fifteen hours after the death of the individual.

June 19.—The committee, consisting of Mr. Taylor, Mr. Booth, and Dr. Hays, to whom was referred a communication, entitled "Notice of the Oolitic Formation in America, with descriptions of some of its Organic Remains, by Isaac Lea," reported in favor of publication, which was ordered accordingly.

In this paper Mr. Lea describes a number of fossils from New Granada and Cuba, which he considers to belong properly to the forms resembling those well known to exist in the Oolites (Jura formation) of Europe. In a note Mr. Lea mentions, that after his paper was written, the work of the distinguished geologist, Von Buch, was received by him from the author. In this work Von Buch describes and figures some of the fossils from the same formation in New Granada, taken by Humboldt nearly forty years since to Europe, which that learned traveller, in his "Essay on the Superposition of Rocks," considered to belong to the Jura formation. Von Buch takes a different view, and places them higher up in the series; that is, in the chalk formation. After a careful perusal of Von Buch's work, and a re-examination of the specimens, Mr. Lea still holds to his previous opinion, that these forms belong properly to the oolitic series, and not to the chalk. He is the more confirmed in this opinion from having since been enabled to examine Captain Grant's Memoir on the Geology of Cutch, recently published in the Geological Society's Transactions of London, Second Series, Vol. V, Part 2; where the forms represented have a strong alliance to those described by Mr. Lea. Captain Grant states that the mineralogical character of the rock "greatly resembles the English lias; but its fossils have been found, after a careful examination by Mr. James Sowerby, to assimilate very closely to those of the oolitic beds," &c.

Mr. Lea's paper contains descriptions of the following species:

Orthocera Humboldtiana, Ammonites Tocaimaensis, Ammonites occidentalis, Ammonites Gibboniana, Ammonites Vanuxemensis, Ammonites Americana, Trigonia Gibboniana, Trigonia Tocaimana, Trigonia Hondaana, Natica Gibboniana, Spatangus Colombianus, Terebratula Tayloriana, Terebratula Poeyana, Tellina [?] Humboldtiana.

The committee, consisting Dr. Patterson, Prof. Bache, and Mr. Walker, to whom was referred a paper, entitled "On the Insufficiency of Taylor's Theorem as commonly investigated, with Objections to the Demonstrations of Poisson and Cauchy, and the assumed Generalization of Mr. Peacock; to which is added, a New Investigation and Remarks on the Development and Continuity of Functions, by Charles Bonnycastle, Professor of Mathematics in the University of Virginia," reported in favor of its publication in the Transactions of the Society, which was ordered accordingly.

The paper of Prof. Bonnycastle is composed of three sections. In the first, which is on the "Development of Functions," he points out and discusses what he considers to be "the errors and conflicting views resulting from the vague manner in which mathematical writers have usually conceived the ultimate object of their peculiar logic." The second section is on the "Continuity of Functions," and the division of this continuity into classes; a subject heretofore touched upon only incidentally by other writers. The principal object of the paper is presented in the third section, which treats of "Functions considered in the order of their magnitude," and particularly of "Taylor's Theorem;" and the author discusses this subject with the care demanded by a theorem which forms the basis of the differential and integral calculus, and which acts so important a part in all the higher mathematics.

Mr. Walker, from the committee on making and collecting observations of celestial phenomena, reported in part, that they had received observations of Lunar Occultations of the fixed stars, which are given in the mean time of the respective places of observation, being a continuation of the list published in No. 6, pp. 71, 72, of the Society's Proceedings, (Vol. XXXVIII, p. 177, of this Journal;) and, on motion, the report was accepted.

The longitudes and latitudes of the American places of observation, as far as they can be determined from a reduction of these and former American observations, have been furnished by Messrs. Walker and Kendall, as follows:

Place of Observation.	North Latitude.			Longitude from Philadel. Obs'ry.			Longitude west from Green'ch.		
	°	'	"		m.	s.	h.	m.	s.
Boston State House, ...	42	21	22.7	E.	16	24.77	4	44	17.13
" Paine's House, . . .	42	20	56	E.	16	25.10	4	44	16.80
Dorchester, Bond's private Obs'ry,	42	19	15	E.	16	24.09	4	44	17.81
Southwick, Holcomb's " "	42	0	41	E.	9	24.83	4	51	17.07
Yale College, New Haven, . .	41	17	58	E.	8	51.00	4	51	50.90
City Hall, New York, . . .	40	42	40	E.	4	37.54	4	56	4.36
Brooklyn, Blunt's private Obs'ry,	40	42	0	E.	4	41.90	4	56	0.00
Nassau Hall, Princeton College,	40	20	50	E.	2	3.70	4	58	38.20
Alexander's House, "	40	20	56	E.	2	4.00	4	58	37.90
Philadelphia High School Obs'ry,	39	57	8			0.	5	0	41.90
" State House, . .	39	56	57.9	E.		2.86	5	0	39.04
Washington, Capitol, ...	38	53	23	W.	7	24.10	5	8	6.00
" Marine Observatory,	38	53	31	W.	7	24.18	5	8	6.08
Hudson Observatory, ...	41	14	37	W.	25	5.56	5	25	47.46
Dover, Ohio, ...	40	30	52	W.	25	14.02	5	25	55.92

The details of the computations on which these results are based, are too extensive for the limits of this report. The longitude of the Capitol at Washington is as follows:

	h.	m.	s.
Marine Observatory, mean of twenty one results according to weights, ...	5	8	5.78
Capitol, ...			5.72
Marine Observatory, mean of six results by transportation of chronometers, by T. R. Paine, between Washington, Philadelphia and Boston, ...			6.32
Whence longitude of the Capitol, . . .	5	8	6.0

July 3.—Mr. Du Ponceau announced that the Society would receive at their next meeting the Anamitic and Latin, and Latin and Anamitic Dictionaries, lately published by the Right Reverend Father Taberd, Bishop of Isauropolis, and Vicar General of Cochin China, which he had mentioned to the Society at a former meeting as in course of publication.

This valuable work was printed at Serampore, under the auspices, and, it is understood, at the expense of the British government in India, and of the East India Company, to whom the learned world are already indebted for the publication of the important labors of the late Dr. Morrison, and other works, which have thrown considerable light on the Chinese language, and who are now, with the same liberality, extending the knowledge of the Indo-Chinese idioms, which, until lately, were entirely unknown in America and Europe. It will not be forgotten, Mr. Du Ponceau added, that this Society was the first to make known the Anamitic language, by the publication of Father Morrone's French and Cochin Chinese Vocabulary, and of the Latin and Cochin Chinese Dictionary, in use among the missionaries in Cochin China, which works, though not so full and so complete as those published by Bishop Taberd, were the first to shed light on that branch of philological science.

Dr. Hare made some observations on the effect of the rarefaction of air, on its desiccation and refrigeration, and on other phenomena connected with the presence of aqueous vapor in the atmosphere. He also detailed some experiments, showing that the phenomena of air, heated by re-entering a receiver partially exhausted, were more consistent, in some respects, with the idea that a vacuum has a capacity for heat, than that it is destitute of any appropriate portion of caloric.

Dr. Hare adverted to the fact, that in an essay published in this Journal in 1822,* he had, agreeably to the authority of Dalton and Davy, stated, that the cold consequent on the rarefaction of air in its ascent towards the upper strata of the atmosphere, was one of the causes of the formation of clouds; and in his text-books he had soon after published an engraving of an apparatus, by means of which he was accustomed to illustrate, before his pupils, the transient cloud which arises from a diminution of pressure in air containing aqueous vapor.

In the essay above mentioned, Dr. Hare had alleged, that as much caloric was given out by aqueous vapor during its conversion into snow, as would be yielded by twice the weight of red hot powdered glass. But Mr. Espy, he considered, had the merit of being the first to suggest, that the heat, thus evolved, might be an important instrument in causing a buoyancy tending to accelerate any upward current of warm moist air.

Dr. Hare had been willing to admit, that this transfer of heat might co-operate with other causes in the production of storms, but could not concur with Mr. Espy in considering it competent to give rise to thunder gusts, tornadoes, or hurricanes. These he had considered, and still considers, to be mainly owing to electrical discharges between the earth and the sky, or between one mass of clouds and another.

With a view to a more accurate estimate of the comparative influence of rarefaction and condensation, in causing evolution of heat in dry air, and in air replete with aqueous vapor, Dr. Hare had performed a number of experiments, of which he proceeded to give a description.

Large globes, each containing about a cubic foot of space, furnished with thermometers and hygrometers, were made to communicate, respectively with reservoirs of perfectly dry air, and of air replete with aqueous vapor.† The cold, ultimately acquired by any degree of rarefaction, appeared to be the same, whether the air was in the one state or the other, provided that the air replete with aqueous vapor, was not in contact with liquid water in the vessel subjected to exhaustion. When water was present, in consequence of the formation of additional vapor, and a consequent absorption of caloric, the cold produced was nearly twice as great

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* See Vol. IV, p. 142.

† The hygrometers were constructed by means of the beard of the *Avena sensitiva* or wild oat, also called animated oat.

as when the air was not in contact with liquid water; being nearly as nine to five.

Under the circumstances last mentioned, the hygrometer was motionless; whereas, when no liquid water was accessible, the space, although previously saturated with vapor, by the removal of a portion of it together with the air which is withdrawn by the exhaustion, acquires a capacity for more vapor; and hence the hygrometer, by an abstraction of one third of the air, revolved more than sixty degrees towards dryness. But when a smaller receiver (after being subjected to a diminution of pressure of about ten inches of mercury, so as to cause the index of the hygrometer to move about thirty five degrees towards dryness) was surrounded by a freezing mixture, until a thermometer in the axis of the receiver stood at three degrees below freezing, the hygrometer revolved towards dampness until it went about ten degrees beyond the point at which it rested when the process commenced.

It appears, therefore, that the dryness produced by the degree of rarefaction employed is more than counterbalanced by a freezing temperature.

As respects the heat imparted to the air above mentioned, the fact, that the ultimate refrigeration in the case of air replete with vapor, and in that of anhydrous air, was equally great, and that when water was present the cold was greater in the damp vessel, led to the idea that the heat arising under such circumstances could not have much efficacy in augmenting the buoyancy of an ascending column of air: but when, by an appropriate mechanism, the refrigeration was measured by the difference of pressure at the moment when the exhaustion was arrested, and when the thermometer had become stationary, it was found cæteris paribus, that the reduction of pressure arising from cold was at least one half greater in the anhydrous air than in the air replete with vapor. This difference seems to be owing to a loan of latent heat made by the contained moisture, or transferred from the apparatus by its intervention, which checks the refrigeration; yet, ultimately, the whole of the moisture being converted into vapor, the aggregate refrigeration does not differ in the two cases.

Agreeably to Dalton's tables, at 70° the quantity of moisture in 31 grains, or 100 cubic inches of air, is $\frac{551}{1000}$ of a grain. The space allotted to this weight of vapor being doubled, it would remain uncondensed at 45° F., being associated with the same weight but double the volume of air; but at 32°, notwithstanding the doubling of the space, only $\frac{356}{1000}$ of a grain would remain in the aëriform state; of course $551-356=\frac{195}{1000}$, or nearly $\frac{2}{10}$ of a grain would be precipitated.

The latent heat given out by the condensation of this vapor, would heat, as is well known, 1000 times its weight of water, or 195 grains, one degree; or 31 grains $\frac{195}{31}=6.29$ degrees; and as the capacity of air for heat is only one fourth of that of water, it would heat 31 grains of air

$6.29 \times 4 = 25.16$, or nearly 25° F. As air at 32° F. expands $\frac{1}{480}$ for each additional degree, the difference of bulk, arising from the heat received, as above calculated, would be $\frac{25}{480}$, or $\frac{1}{19}$ nearly.

When air replete with aqueous vapor was admitted into a receiver partially exhausted, and containing liquid water, a copious precipitation of moisture ensued, and a rise of temperature greater than when perfectly dry air was allowed to enter a vessel containing rarefied air in the same state. In the instance first mentioned, a portion of vapor rises into the place of that which is withdrawn during the partial exhaustion. Hence, when the air, containing its full proportion of vapor, enters, there is an excess of vapor which must precipitate, causing a cloud, and an evolution of latent heat from the aqueous particles previously in the aëriform state. Dr. Hare conceives that as the enlargement of the space occupied by a sponge, allows proportionably a larger quantity of any liquid to enter its cells, so any rarefaction of the air when in contact with water, consequent on increase of heat or diminution of pressure, permits a proportionably larger volume of vapor to associate itself with a given weight of the air. When, subsequently, by the afflux of wind replete with aqueous vapor, the density of the aggregate is increased, a portion of the vapor equivalent to the condensation must be condensed, giving out latent heat, excepting so far as the heat thus evolved, being retained by the air, raises the dew point.

Hence, whenever a diminution of density of the air inland causes an influx of sea air to restore the equilibrium, there may result a condensation of aqueous vapor, and evolution of heat, tending to promote an ascending current. This process being followed by that which Mr. Espy has pointed out, of the transfer of heat from vapor to air, during its ascent to the region of the clouds, and consequent precipitation of moisture, might, Dr. Hare thought, be among the efficient causes of those *non*-electrical rain storms, during which the water of the Gulf of Mexico, or of the Atlantic, is transferred to the soil of the United States.

Dr. Hare proceeded to mention some additional experiments which he had made respecting the increase of temperature resulting from the admission of dry air into an exhausted receiver. When the receiver was exhausted so as to reduce the interior pressure to one fourth of that of the atmosphere, and one fourth was suddenly admitted, so as to reduce a gage from about 22½ inches to 15 inches, heat was produced; and however the ratio of the entering air to the residual portion was varied, still there was a similar result.

When the cavity of the receiver was supplied with the vapor of ether or with that of water, so as to form, according to the Daltonian hypothesis, a vacuum for the admitted air, still heat was produced by the latter, however small might be the quantity or rapid the readmission. When the receiver was exhausted, until the tension was less than that of aqueous vapor at the existing temperature, so as to cause the water to boil, as in the Cryophorus, or Leslie's experiment, still the entrance of $\frac{6}{1000}$ of the quantity requisite to fill the receiver caused the thermometer to rise a tenth of a degree. An alternate motion of the key of the cock, through one fourth of a circle within one third of a second of time, was adequate to produce the change last mentioned.

Dr. Hare considered the fact, that heat is produced, when to air, rarefied to one fourth of the atmospheric density, another fourth is added, irreconcilable with the idea that this result arises from the compression of the portion of air previously occupying the cavity, since the entering air must be as much expanded as the residual portion is condensed.

As, agreeably to Dalton, a cavity occupied by a vapor acts as a vacuum to any air which may be introduced, Dr. Hare argued, that when a receiver, after being supplied with ether or water, is exhausted so as to remove all the air and leave nothing besides aqueous or ethereal vapor, the heat, acquired by air admitted, cannot be ascribed, consistently, to the condensation of the vapor.

The facts above stated, he added, are not reconcilable with the idea of De la Rive and Marcet, that the first portion of the entering air is productive of cold, although a subsequent condensation is productive of an opposite change. The effect upon the thermometer was too rapid, and the quantity of the entering air too minute, to allow it to be refrigerated by rarefaction in the first place, and yet afterwards to be so much condensed as to become warm by the evolution of caloric.

Notwithstanding the experiments of Gay Lussac and of those of De la Rive and Marcet, there appeared to Dr. Hare to be evidence in favor of the heat being due to the space rather than to the air which it contained.

With respect to Gay Lussac's celebrated experiment with the Torricellian vacuum, supposing such a vacuum to be a pre-eminently good liberator of heat, as it ought in reason to be, the caloric would be absorbed by the mercury as rapidly as this metal could be made to encroach upon the space occupied by the calorific particles.

Admitting, that for equal weights, the specific heat of air is seven times as great as that of mercury, there could not have been a capacity greater than that of about 200 grains of the metal, whereas a very small stratum of this metal, equal to one fourth of an inch, would, in the apparatus employed, amount to more than a pound.

The rapidity with which a mercurial thermometer is affected by the changes of temperature in experiments like those which he had been describing, showed, in Dr. Hare's opinion, that there was something not yet understood respecting the transfer of heat in such cases. It was hardly reconcilable with the process of conduction or circulation, as ordinarily understood.

In the experiments of De la Rive and Marcet, in which the entering air being made to impinge upon the bulb of a thermometer, was productive of a fall in the thermometric column, it might be inferred, he conceived, that the bulb interfered with the access of caloric from the space. It was in fact the bulk upon which the air acted previously to its distribution in the space where it could have encountered the due proportion of caloric.

Prof. Bache, from the committee on magnetic observations, read an extract from a letter of Major Sabine, V. P. of the Royal Society of London, stating that the Council of the Society had, on the recommendation of the Committee of Physics, expressed their opinion of the importance to the plan of combined magnetic observations now in progress, that observatories should be established in the United States, and had instructed their President to bring this expression of opinion to the knowledge of the government of this country.

Prof. Bache stated that the resolution just referred to had been adopted with a view to aid the efforts of this Society in procuring the erection of observatories, as recommended in their memorial to the Secretary of War, which had been referred by that officer to Congress.

He also read an extract from a subsequent letter from Major Sabine, in reference to the progress of the combined magnetic observations, stating that the Emperor of Russia had ordered the erection of nine magnetic and meteorological observatories in his dominions, to conform, in respect to instruments and times of observations, to the system recommended by the Royal Society. One of these observatories is to be upon the northwest coast of America.

Prof. Bache stated, that the regular system of bi-hourly magnetic and meteorological observations was now established in the observatory at the Girard College, and had been in progress since the close of the month of May. He intended, at a future day, to present to the Society the names of the gentlemen, chiefly members of the American Philosophical Society, by whose contributions a fund had been raised to defray the expense of employing the assistants required for these observations.

On the occasion of the May magnetic term-day for observations at short intervals, [29th,] a brilliant aurora had occurred, during which the magnetic instruments were very much disturbed. The details were reserved for future presentation, but it was perhaps proper now to state, that an auroral arch had been visible here a little after ten o'clock. The same phenomenon was observed at Southwick, Mass., by Mr. Holcomb, at a much earlier hour.

July 17.—Dr. Hare made a communication respecting an extensive voltaic apparatus, of the form which he had designated by the name of galvanic deflagrator. This apparatus had been constructed for the Lowell Institute of Boston, under his direction, by request of Prof. Silliman.

It consists of four troughs, each containing 100 pairs within a space of about 30 inches in length. The pairs, severally, are of the Cruickshank pattern, and about 6½ inches square, independently of the grooves, so as to expose about 42 inches of zinc surface. Every fifth plate is cemented into its groove by a compound of rosin and suet. The plates, intermediate between those thus cemented, are made to fit tightly into their grooves; but in consequence of a slight obliquity in their sides, can be extracted by the aid of forceps, so as to be cleansed, and, when expedient, scraped. The cementing of each fifth plate tends to prevent any injurious retrocession of the voltaic fluid; and yet when the intermediate four plates are removed, an interstice is vacated sufficiently large to allow the stationary metallic surfaces to be reached by a scraper. The plates are all amalgamated, which not only renders them less susceptible of wasteful reaction with acid, but more susceptible of being cleaned. A strip of wood 13 inches wide and 2 inches deep, is bored by a centre bit, so as to have eight vertical and cylindrical holes, which are all supplied with mercury. By means of ropes of copper wire, these holes are made to communicate severally with the poles of each of the troughs, so that every one of these has its corresponding mercurial receptacle. Arches of twisted copper wire are provided of such various lengths, that the receptacles may be connected in such manner as to cause the associated troughs to act either as one series of 400 pairs each of 42 inches of zinc surface; as a series of 200 pairs each of 84 inches of zinc surface; or as a series of 100 pairs each of 168 inches of zinc surface. In the usual mode of constructing the voltaic apparatus, the diversities of power that appertain to an apparatus in which the ratio of the size of the pairs to their number varies, as above described, can be produced only by changes in the arrangement, which are too inconvenient to be employed; but, according to the contrivance described, are attainable simply by shifting the connecting arches, so as to alter duly the mode in which the receptacles are connected with each other.

By means of this apparatus, the deflagration of metals, the arched flame between charcoal points, the fusion of platina by contact with the aqueous solution of chloride of calcium, the welding of iron wire to a rod of the same metal under water, were all accomplished with the most striking success.

In repeating Davy's experiment, in which the arched flame between charcoal points was subjected to the influence of a permanent magnet, the reaction between the voltaic and magnetic fluids was so violent, as to be productive of a noise like that of small bubbles of hydrogen inflamed in escaping from the generating liquid. This last mentioned experiment was performed by request of Prof. Henry, who manipulated in the performance of it.

Dr. Hare stated, that he had for many years endeavored to draw the attention of men of science to the fact, that if, when a fine and a coarse wire of platina are made to form the electrodes or poles of a powerful voltaic series of not less than 300 pairs, the coarse wire, while forming the positive end or anode, be introduced into a concentrated solution of chloride of calcium, and the fine wire be made to touch the surface of the solution, fusion of the extremity into a globule will follow every contact. But when the polarity of the wires is reversed, the resulting ignition is comparatively feeble.

This experiment, Dr. Hare stated, was repeated to the satisfaction of Professors Silliman, Henry, and James Rogers, all of whom were present at the trial of the apparatus.

When the finer wire was plunged about an inch below the surface of the solution, it became luminous throughout, emitting rays of a brilliant purple hue.

For the fusion of the platina wire, in the experiment above described, it was found necessary to use the whole series consecutively as 400 pairs; showing, Dr. Hare remarked, that there are effects which require a great number of pairs. He had, in previous experiments, found that fresh phosphuret of calcium was a conductor for 350 pairs of 7×3, but not for 100 pairs of $7\frac{1}{2} \times 14$.

The deflagration of an iron wire by contact with mercury, took place with phenomena which were never before witnessed by any of the spectators. At first the mercury was deflagrated with an intense silvery white light, after which there arose a vertical shower of red sparks, caused by the combustion of the iron. Lastly, a globule having accumulated at the end of the wire after a momentary stoppage of the reaction, an explosion took place, by which fragments of the globule, together with portions of the mercury, were projected to a great distance.

It would seem, said Dr. Hare, as if a globule of peroxide of iron, having formed at the end of the wire, caused a temporary arrestation of the voltaic current; but that the apparatus, gaining energy in consequence of a transient repose, was enabled to break through the globule so as to disperse its particles with violence.

August 21.—Mr. Boyé stated, that Mr. Clarke Hare and he had succeeded in producing a perchloric ether.

It is a colorless liquid, heavier than water, and of a sweet, but afterwards acid taste, resembling that of the oil of cinnamon. Its most remarkable property is its explosiveness. Not only by ignition, but even by friction or percussion, it explodes with extreme violence, and cannot therefore be handled without the greatest precaution. When it is borne in mind that perchloric acid, containing seven atoms of oxygen, loosely combined with chlorine, is in this substance, in contact with sufficient carbon and hydrogen to be converted into carbonic oxide and water, the violence of its explosion will easily be accounted for.

Mr. Boyé further stated, that he hoped to be soon able to give a farther account of this substance; of the way in which it is obtained, and of some other similar reactions, which they are now engaged in studying.

Mr. Vaughan exhibited from M. Alexandre Vattemare, a fac simile of an original grant by Charles of England to William Penn; and also a fac simile of a deed of sale, by William Penn, of 20,000 acres of land, for 800 pounds sterling; the original deed being in Penn's hand-writing.

Mr. Walker made an oral communication on the subject of the August shower of meteors.

These meteors returned this year on the 9th instant, and were observed at the High School Observatory, by Mr. Walker, as well as by Messrs. Forshey, of Louisiana, and Hamilton, of this city. The evenings of the 10th and 11th, being partly cloudy, and the moon nearly full, no observations were made. The evening of the 9th, however, was distinguished by all the peculiarities hitherto noticed in the August period. The following table exhibits a classification of the meteors from memoranda, concerning each meteor, made at the time of its appearance.

Meteors of August 9th, 1840. Comparative brilliancy.	Of 68 meteors seen from 8h. to 14h. by one observer, moon nearly full.	Of 103 meteors seen after setting of moon at 14h. by one observer.	Visible path of meteor in arc of great circle.	Duration of visibility of meteor and train.	Length of train visible at once.	Duration of visibility of train.
			°	s.	°	s.
Thrice that of Jupiter,	1	1	40	4.5	20	1.7
Twice " "	6	0	35	3.6	15	1.0
Equal to " "	12	2	25	2.5	12	0.8
First magnitude,	12	14	20	1.8	9	0.6
Second "	32	17	12	1.2	5	0.5
Third "	5	33	7	0.9	4	0.4
Below third "	none	36	6	0.6	4	0.4

From an inspection of the table, Mr. Walker remarked, it will readily appear, that these meteors differ from ordinary *shooting stars*, in their greater brilliancy, longer apparent paths, and the greater duration of their trains. Their most important peculiarity, however, is the tendency of their apparent paths towards a common point of convergence in the celestial sphere, or in other words, their apparent divergence from a common radiant point near the head of Perseus.

The existence of a common radiant point near γ Leonis, for the great display of meteors, November 12th, 1833, was noticed by Messrs. Olmsted, Twining, Aiken, Riddell, and others. The same may be inferred from the descriptions of Humboldt and Ellicott, in 1799; of Briggs, and others, in 1832; and it has been manifest in every return of the November shower witnessed since.

The attention of observers, Mr. Walker remarked, was first called to the August period, by Quetelet, in 1836; and in 1837, precise observations were made at the Berlin and Breslaw observatories. These were reduced by the formulæ given by Mr. Erman, in No. 385 of Schumacher's *Astronomische Nachrichten*, and have determined with precision the common point of convergence for August 10th, 1837. In the same year Mr. Forshey, then Professor of Mathematics in Jefferson College, Mississippi, noticed, about the middle of August, a great number of meteors, originating chiefly about the region of Cassiopeia. It appears, also, that Mr. Schaeffer,* of New York, searching for a radiant point on the 9th of August, 1837, placed the same near the north pole. Mr. Herrick,† at New Haven, who had previously invited attention to this period, in the United States, on the same evening, found this point farther north than in the November shower; but determined nothing farther. In 1838, these meteors were seen by Mr. Kreil, at the Milan Observatory, but no radiant point was deduced. In the United States, however, Professor Forshey, from sixty five meteors seen in one hour, August 9th, at Rock Island, Iowa, concluded the radiant to be situate within a circle of 2° radius, centering in the sword cluster of Perseus. In 1839, Mr. Herrick,‡ with others, at New Haven, found the radiant point to be near the sword cluster, on the 9th and 10th, being nearly stationary. On the 10th, at 13h. they found it to be near θ Persei.

Mr. Forshey, in 1839, August 10th and 11th, at St. Louis, again noticed the radiant point in the same position as in 1838. But the position of this point, or rather the point of convergence of their apparent paths, has been computed with great precision from the observations at Berlin, August 9th, 10th, and 11th, and at Königsberg, August 10th and 11th. The mode of observation adopted at the European observatories has been to mark on a map the points of origin and disappearance, and, subsequently, to compute, by Mr. Erman's formulæ, the common point of convergence. As the August meteors become visible chiefly in the northern zones, it was thought that greater precision would be attained by noting, besides the point of origin and disappearance, also the part of Perseus or Cassiopeia, intersected by the apparent path of the *conformable* meteors, traced backwards through one of these constellations. The following table gives the point of convergence thus deduced from three separate groups of observations at Philadelphia, together with the position of this point, as determined at the European observatories, and the probable error of a single result, and of the final result computed in the usual manner. The general agreement in the positions will be seen. The smallness of the probable errors of the Philadelphia results is attributed to the

* Silliman's Journal, Vol. XXXIII, p. 134.

† Ibid. pp. 176 and 359.

‡ Ibid. Vol. XXXVII, p. 328.

method employed in observing; by which a greater proportion of the meteors seen was marked *unconformable*, and excluded from the general estimate.

August meteors. Place of observation and date.	Apparent R. A. of the point of convergence.	Apparent Declin. of the point of convergence.	No. of observations.	Probable error of single result.	Probable error of final result.
1837. Berlin, August 10,	217°.18	−57°.26	46	±20°.1	±2°.96
Breslaw, " 10,	221.76	−51.41	200	±19.5	±1.38
1839. Berlin, " 9,	224.86	−50.18	50	±11.9	±1.68
1839. Berlin, " 10,	223.88	−52.39	48	±13.3	±1.92
1839. Berlin, " 11,	218.45	−51.05	43	±13.5	±2.06
1839. Königsberg, 10,	214.85	−55.59	75	±21.0	±2.42
1839. Königsberg, 11,	215.11	−55.29	74	±17.4	±2.02
1840. Philad. 9d. 10h. 57m.	216.14	−55.76	12	± 2.3	±0.67
1840. Philad. 9 13 4	214.71	−55.43	15	± 4.1	±1.05
1840. Philad. 9 15 6	219.25	−55.12	29	± 1.2	±0.22

Mr. Walker referred to some of the analytical conclusions drawn by Mr. Erman* from the fact, which the Philadelphia observations of this year go to confirm, that these meteors appear to converge nearly to a common point in the heavens.

"1st. Mr. Erman concludes, that these bodies are of a *cosmical* origin; that they move in a continuous ring-formed stream, of not less than 3° in breadth; that the plane of the center of this stream is inclined at least 56°, probably more than 90°, and not exceeding 124°, to the plane of the ecliptic,—an inclination which hitherto comets alone have been known to possess.

"2d. That their least velocity in space Aug. 10.5th, is 55 hundredths that of the earth in its orbit, giving them a period round the sun of 128 days; that their greatest velocity is 143 hundredths that of the earth, which would locate them at this time on the perihelion of a parabola or ellipse of period indefinitely great.

"3d. That to remove this uncertainty of their velocity, between 55 and 143 hundredths that of the earth, it is only necessary that two observers, at a distance apart, should trace with precision the apparent path of the same meteor, and one of them at least its duration. This condition had not yet been fulfilled in Europe, otherwise the entire elements of their orbit would have been approximately determined.

"4th. That their perihelion distances are not less than 2 hundredths nor more than 97 hundredths of the earth's mean distance from the sun.

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* Astr. Nachr., Nos. 385, 390, and 404.

"5th. That they are in their descending node when visible Aug. 10.5th, and that their distance from the sun, in the ascending node, is not less than 7 hundredths, and may be several times the earth's mean distance from the sun. Hence, even if they are a continuous ellipse-formed stream, it is only in one of these possible distances, viz. that of the earth from the sun; that this stream would be visible to a spectator on the earth, when traversing its ascending node. If, near the sun, their aggregate might appear as spots on the solar disc, or might intercept some of the solar light and heat: if far beyond the earth, no traces of them would be found.

"6th. That the earth traverses this meteor-stream from the 5.5th to the 7.5th of February. The fact that no such stream has of late years been noticed, shows that the first condition of No. 5, does not prevail. Mr. Erman thinks that the diminution of the normal increase of temperature at this date, as ascertained at several stations, for many years past, by Mr. Mädler, of Berlin, may possibly warrant the conclusion, that the second condition takes place, and that the meteor-stream at this time is between the earth and sun. That the first condition may have prevailed in 1206, and the second in 1208, seems not improbable from history. This apparent change in the appearance of the meteor-stream Mr. Erman ascribes to the secular variations of its elements; the possibility of which is admitted by Olbers and Bessel.

"7th. That the greatest possible apparent motion of the common point of convergence of their apparent paths, consistent with the existence and observed position of this point, is *one-tenth* of a degree of a great circle *westward, in an hour.*"

Mr. Walker remarked, that though much pains had been bestowed upon determining their apparent paths and duration, at the High School Observatory, he had as yet received no corresponding observations which could throw light on the third conclusion of Mr. Erman. The motion of the radiant—if any—according to Mr. Forshey's and his own observations, would seem to be in a *south-easterly* direction, of about *one half* of a degree of a great circle *per hour*, a phenomenon not reconcilable with the analysis of Mr. Erman.

In conclusion, Mr. Walker referred, for the details of the Philadelphia observations, to Mr. Forshey's paper read this evening.

Dr. Hays communicated the particulars of a case of inability to distinguish certain colors, occurring in a man, a patient in Wills's Hospital, under the care of Dr. Fox.

This case, Dr. Hays remarked, presented the following points of interest.

1st. It confirmed the correctness of the observation made by Dr. Hays, in a former communication, that no reliance can be placed on the account of their own cases, given by those who labor under this defect; and that their statements should never be received as accurate, until after careful and repeated examination.

The subject of the case under notice had been admitted into the hospital with partial amaurosis, and was not aware of his inability to distinguish colors until he was informed of the defect by Dr. Fox. He then maintained, very confidently, that it had come on since his loss of the power of seeing objects, and mentioned several circumstances to prove that it was of recent occurrence. Nevertheless, on being minutely and closely questioned, it appeared beyond all doubt, and even the patient himself had to admit the fact, that the defect must have always existed.

Again, after being shown various colored papers, which he was requested to name, and satisfying all who witnessed the experiment, that he could distinguish but two colors, viz. yellow and blue, he named correctly the colors of a red strawberry and green leaf, which were presented to him. This surprised all present. It occurred, however, to Dr. Hays, that the patient had learned the usual colors of these objects, and that his answers were dictated by this knowledge, and not from a real perception of color. Experiments, made with a view of determining this point, most conclusively established the correctness of Dr. Hays's suspicion.

2dly. The case tends to confirm the accuracy of the laws announced by Dr. Hays on a former occasion, as governing the defect of vision under notice. This patient could perceive but two colors, yellow and blue. His perception of the former was perfect, of the latter somewhat less so.

Dr. Hays stated, that the laws just alluded to, so far as ascertained by his investigations, were the following:—

1st. *Entire inability of distinguishing colors may co-exist with a perfect ability of perceiving the forms of objects.*

This constitutes the highest grade of the defect. Individuals who labor under it can recognize differences of intensity of color, so that whilst a diversity of colors of the same intensity appears to them to be a uniform color, they accurately designate, as lighter or darker, different shades of the same color, or of various colors. The rainbow appears to them as a band of a uniform color, darker at one side, and gradually becoming lighter towards the other.

2dly. *The defect may extend to all but one color, and in such case the color recognized is always* YELLOW.

The perception of this color may be perfect, or limited to some shades.

3dly. *The defect may extend to all but two colors, and in such case the colors recognized are always* YELLOW *and* BLUE.

In some of these cases, the perception of the latter color is less perfect than of the former. Individuals who labor under this grade of the defect, though able to recognize, perfectly, yellow and blue, cannot distinguish them when combined, and forming green.

The laws which govern the other grades of this defect, Dr. Hays remarked, remain to be determined.

There are certain persons who can accurately recognize yellow and blue, and some who can recognize red, who cannot distinguish green; but whether or not there are individuals who can recognize the three primitive colors accurately, and are yet unable to distinguish the secondary colors, must be left, Dr. Hays remarked, to further observation to determine.

It also remains to be ascertained, whether any person, having an imperfect perception of yellow, can recognize blue; or with an imperfect perception of yellow and blue, or of the latter alone, can distinguish red.

Sept. 18.—A letter from Dr. John Locke, of Cincinnati, stated the results of two series of observations, each made with three horizontal needles, and concludes from the mean of them, that the relative horizontal intensities at Louisville and Cincinnati, are as 1 to 0.9727. The dates of the observations were March 7th, 10th, 11th, and 14th, 1840, at about noon of each day. The correction for temperature, in each of the three needles used, was obtained by experiments which are fully described, and which gave the following coefficients:—for needle No. 1, 0.000125; for No. 2, 0.000145; No. 3, 0.000058.

The magnetic dip at Cincinnati, as determined by two series of observations, each with two needles, in March, 1840, was 70° 25′.5, and by one series, in April, 70° 28′.8, and the dip at Louisville, by three series, at nearly the same date, in March, 69° 54′.9.

The relative total intensities thus deduced for a period corresponding to March 10th, 1840, are,—Cincinnati, 1.000; Louisville, 1.003.

Oct. 2.—The Committee, consisting of Dr. Horner and Dr. Hays, appointed on the 3d of January last, to report to the Society a description of a donation of Mastodon Bones, made to the Society by a subscription of members, gave in their report, which was directed to be printed in the Transactions of the Society.

The Committee, consisting of Dr. Hays, Mr. Peale, and Dr. Dunglison, to whom was referred a paper entitled "Note of the Remains of the Mastodon, and some other extinct animals, collected together in St. Louis, Missouri; by W. E. Horner, M. D., Professor of Anatomy, University of Pennsylvania," recommended that an abstract of the same should be inserted in the Bulletin of the Society's Proceedings; and on motion, the report was accepted, and the committee discharged.

The collection referred to, was made by Mr. Albert Koch—a German resident in St. Louis, for the last five years—and has been obtained principally from two localities, Rock Creek, twenty miles south of St. Louis, and Gasconade County, two hundred miles above the mouth of the Missouri river. It consists of two hundred or more teeth of the mastodon and of the American elephant, a dozen or more lower jaws of the mastodon, with very numerous specimens of other parts of the head and skeleton generally, though there is no perfect head.

The most remarkable specimen is a head of an animal, which Mr. Koch calls nondescript, and considers to have been from four to six times the size of an elephant, though Dr. Horner esteems it extremely difficult to establish this. In the present mode of exhibition, the head shows a central oblong amorphous part, which measures six feet in length by two or three in width. It is furnished with enormous tusks, eleven and three-twelfths feet long from their roots, and nine or ten inches in diameter—one foot and three inches of their length being inserted into the sockets. These tusks are semicircular, and stand out horizontally, with the concavity backwards. Thus placed, they are fifteen feet in a straight line, from the tip of the one to the tip of the other. Notwithstanding they were found in this position, very just doubts, Dr. Horner thinks, may be entertained of its being the natural one, as, in a state of decay of the alveolus, they might readily gravitate outwards, so as to assume that direction, subsequent to the death of the animal. This specimen was in fact very much decayed, when Mr. Koch found it, and appears to have been fractured by rocks falling on it from the bluff above. The means taken to preserve it, obscure the surface of the bones, as well as their configuration, and in attaching the fragments together, some have been put very much out of their position. For example, the glenoid cavity of the right side is monstrously far from the hind tooth, and is laterally much beyond its line: the intermaxillary bones are too long, and on comparing the position of the posterior molar teeth of the upper jaw with that of the lower, the upper molar teeth are found to be ten inches or more in advance of the lower, a relation so false and so unsuited to mastication, that it is not at all probable nature formed them thus. The molar teeth are four in number in each jaw—two on a side; the posterior one is seven inches long by four wide; the anterior, four and a half inches long by four wide. The conformation of the teeth is exactly that of the mastodon, and the ridges and denticules are scarcely worn at all, a proof that the animal was not old. The upper part of the cranium of this animal is defective. The general configuration of the head is so amorphous, the fragments of which it is composed have their position so imperfectly regulated, and the whole surface is so coated with glue and paint, to preserve it, that an exact examination was impracticable. Its length is so extraordinary, that Dr. Horner considers it can scarcely be received as natural, and he is inclined to the opinion, from its dental system, that it belongs to the mastodon; that by some accident the remains of two heads were found in the same line; that if there be but one, it has been much fractured, and a large quantity of extraneous matter blended with it, which it is difficult to distinguish. The latter conjecture, Dr. Horner thinks, is rendered more probable by the admission of Mr. Koch, that these bones were cemented to a layer of gravel a foot and a half in thickness, with such tenacity that the separation was accomplished with the greatest difficulty.

In the same collection of fossil bones is to be found the skeleton, nearly complete, of a mastodon of very large size; the ribs, and the upper part of the cranium are wanting. The transverse diameter of the head, on a line with the foramen magnum, is three feet. The os femoris, in a perpendicular line, stands three feet nine inches high, and all the other bones are in this proportion. An estimate of the altitude of the animal when living, founded upon careful observations, instituted with the same view on the skeleton from Bucyrus, Ohio, recently obtained by the Society, would leave the inference that the former animal has reached a height of from twelve to thirteen feet at the shoulders. This animal, in a popular advertisement on the subject of the museum by Mr. Koch, is rated at eighteen feet in height; an altitude so great as to exceed much the evidence derivable from a measurement of the longest bones of the extremities, and the inductive and comparative estimate thence obtained.

The internal table of the cranium, the brain case, is entire, with a small surface of the contiguous cellular structure of bone in another fragment of the mastodon. This forms so complete an oval body, that, in Dr. Horner's opinion, it is somewhat difficult to conceive that its shape was the result of merely accidental causes; Dr. Horner, indeed, thinks it rather authorizes the inference that it had been chiselled or hammered designedly into that shape by the human cotemporaries of the animal.

There is also a small head eighteen or twenty inches long, with tusks ten or eleven inches long in the upper jaw, and four mastodon teeth on each side of each jaw. This head is somewhat broken. The os frontis and the face, so far as Dr. Horner could judge, are so placed in regard to their front surface as to form a deep circular concavity, approximating, in shape, a fragment in the cabinet of the Society. Whether it ought to be viewed merely as a young Mastodon giganteum, or another species of the mastodon, Dr. Horner considers to be at present doubtful.

There are two radii of the mastodon with the epiphyses or articular ends detached, owing to the youth of the animal: these pass for the arm bones of a giant fourteen or fifteen feet high when his skeleton was complete. A similar misapprehension exists in regard to the vertebræ of a quadruped, probably a buffalo or young mammoth, which are strung together in a vertical position and pass for the back bone of a giant of similar kind.

Another interesting relic has been denominated by the proprietor Missourium Kochii, the first name in commemoration of its locality, the second of himself, its discoverer. It belongs undoubtedly, Dr. Horner states, to the mastodon race; was not much inferior in size to the elephant, and was furnished with tusks and indications of a proboscis having been attached to it. The tusks are four and a half feet in length, and at the roots have a circumference of eighteen inches; they are only half an inch apart at the socket, and project right and left, with the concavity forward. The teeth have the mammillose or mastodon shape and conformation, and are three and a half inches in length by two and a half in breadth. The lower jaw is wanting.

There is an os humeri, probably of a megalonyx, which measures in length one foot eight inches, the ulna of the same animal, and also other bones, probably the radii, with some of the last phalanges.

Dr. Horner stated, that his sketch of this rich accumulation of fossil remains and their examination were very imperfect, and the less instructive to him, for the want of standards of comparison in perfect skeletons, and in plates, neither of which means of elucidation exist in St. Louis, and he expressed a hope, that "their diligent and deserving collector would furnish the scientific world with exact plates of such as are rare or unknown."

Art. V.—*Additional Remarks on the Tails of Comets;* by Wm. Mitchell, of Nantucket, Mass.

It is a weakness common, I believe, to most men, to adhere with more or less pertinacity to first impressions; it is manifested in childhood, and is often strengthened by age. From this delusive error, in the discussion in which I now engage, I can scarcely hope, though I strongly desire to be entirely free. The end of all inquiry should be truth, which is the only legitimate object.

In Vol. xxxviii, No. 1, I was indulged with the occupancy of a few pages for the publication of an essay on the tails of comets. The object of the article and its only hope, was to invite the attention of those familiar with this and kindred subjects, to a very simple, and to myself, satifactory explanation of the phenomenon; being principally the result of my own observations on the comets visible in this part of the world during the last thirty years; viz. that *their tails are formed by the sun's rays, slightly refracted by the nucleus in traversing the envelope of the comet, and uniting in an infinite number of points beyond it, throwing a stronger than ordinary light on the ethereal medium, near to, or more remote from the comet, as the ray from its relative position and direction is more or less refracted.* In support of this theory, I adduced very briefly the facts and the reasoning which had established it in my own mind.

Productive as this subject has always been of the rudest speculation, surrounded with absolute difficulty, and subjected as it still is to formidable prejudices, I had little doubt that first impressions at least, would be generally unfavorable to the theory. In this I have been disappointed; for whatever may have been the misgivings of any one who has given the subject deliberate thought, cursory readers, for the most part, have spared their criticisms.

In a religious and literary Journal, published in Philadelphia, under the title of "The Friend," an anonymous article made its appearance, denouncing the theory as unphilosophical, and the train of objections which the writer presented, I hope to be fortunate enough to examine with candor.* The first objection which he raises, and which he denominates the *great* one, is an unqualified declaration, "that there cannot be any substance pervading space sufficiently dense to reflect the light thus cast upon it, so as to be perceptible," adding that "no one can imagine that the exceedingly subtle vapor which may pervade the planetary space can possibly reflect the strongest light which can be cast upon it, for if such were the case, the light coming from the fixed stars would also be partly (if not entirely) reflected, and in consequence it would be barely possible for a sufficient quantity of light to escape reflection to render them visible, considering their immense distance," &c. Now if these views can be established, my theory is at once void. But I would ask, not for the sake of those who are familiar with the subject, but for the casual reader of these articles, to what point of the creation the whole light of the firmament would be reflected by a medium occupying all space! We will suppose, however, the author unhappy in the choice of the term, and that he would have had the light of the stars "partly, if not entirely" *absorbed* by the ethereal medium. To this I should say, that *man* having never witnessed any change of aspect under which he has contemplated the heavens, knows not, nor can he know, what degree of brightness the stars would have exhibited in the absence of an ethereal medium; nor does

* In a subsequent number of the paper, I invited the writer to a discussion in this Journal, under his proper signature. In the hope that he would accept the invitation, I have till now deferred any further notice of the article; and, although he has not appeared, his objections are made the basis of this additional essay, inasmuch as they afford an opportunity of further illustration of the theory.

he know, though he may yet learn, the amount of his indebtedness to this very medium for the transmission of all light. It is generally known that the propagation of light has received two different explanations. One by Newton, who supposed it to consist of minute particles projected from all bodies by an inherent force. Another by Huygens, the great Dutch astronomer, who believed light to be transmitted to the optic nerves by vibrations, communicated by luminous bodies to the particles of an ethereal medium. The Newtonian theory, it has long been acknowledged, cannot be true, being entirely inadequate to an explanation of a great variety of optical phenomena.* The Huygenian hypothesis, somewhat analogous to the theory of sound, illustrates in a satisfactory and beautiful manner, the general phenomena of light, and its propagation; and the experiments of Fresnel and Young having rendered it nearly unquestionable, it has received the sanction of the ablest philosophers of the present age.† Assuming this theory as the true one, the ethereal medium, instead of an impediment, is indispensable to the transmission of light. Thus, in any view of the subject, this "great objection," as the writer styles it, to make the most of it, may not be the greatest.

"We cannot suppose," continues the writer, "that if all the light cast on a comet at that distance from the sun at which the tail begins to be formed, was concentrated into one point, its intensity would be nearly so great as that of the light received directly from the sun in the space immediately surrounding him. If, therefore, the theory proposed were correct, we should expect to see the sun enveloped in a luminous vapor which would extend many thousands, if not millions of miles." To this I answer, that neither the sun, nor the region of the sun, has ever been seen under any material change of circumstances, to say nothing of the zodiacal light, which it is to be hoped the writer has seen. The light of a comet's tail is not in itself a strong light; its brilliancy, as I apprehend, is mainly to be attributed to the fact of its shining in a region of extreme darkness; for if an object, even of dark color, retaining the ordinary light of the sun, could be presented to our view in the darkness of night, its brilliancy would

* Young's Lectures, Vol. I.

† In an address to the Astronomical Society of London, Sir J. F. W. Herschel has the following remark: "Of the existence of such a fluid as the efficient cause of *light*, we have demonstrable evidence." London Athenæum, for Feb. 1840.

be astonishing. If the tail of a comet were a brilliant object, we might expect to witness from its radiance, at least a degree of the light imparted by the moon, and by the planets, it having frequently the magnitude of many moons and planets; but no such effect is witnessed. Yet in those regions far beyond the atmosphere of the earth, a vast combination of faintly illuminated particles, it is rational to conclude, would be distinctly visible, even though an individual point might be beyond telescopic power.

"Another objection," says the writer, "to this theory is, that if the rays of the sun are refracted by the vapor of the comets, so as to form a luminous train, the same thing should occur to the planets, at least to the two inferior planets." So many objections at once present themselves to this view, that it has occurred to me to give the summary one, that *some comets* have no tails. Like causes, it is to be admitted, should produce like effects; but not under unlike circumstances. I have not attempted to explain why some comets have no tails, a subject far more difficult than the one proposed. In the first place, why did the writer say, "at least, the two inferior planets." It is evident that one at least of the many manifest points of difference between the circumstances of a planet and those of a comet had presented itself to his mind. That the planets, in common with the earth, are accompanied by atmospheres, I have no doubt. That of the earth is exceedingly limited,—that of the moon still more so; nor is there conclusive testimony that the atmosphere of any planet bears any considerable proportion to its diameter. The atmosphere of the earth capable of reflecting the sun's light, does not exceed the one hundred and sixtieth part of the earth's radii, and a portion of this is sufficiently dense to absorb a measure of the sun's light, and the want of combination in the few more vivid rays which escape material absorption, even assuming that the chemical properties of the atmosphere are identical with those of a comet's envelope, would render them invisible. In the second place, though comets in all cases are accompanied with a shining envelope, in appearance analogous to an atmosphere, yet its relative position bears no resemblance whatever to the atmosphere of the earth, nor to those phenomena which indicate the existence of atmospheres in the planets. The envelope of a comet which has a tail, is visible only on the side of the comet next to the sun, and detached entirely from the nucleus, (compared by some writer to a *hemispherical cap,*) and the zone between the nucleus and the envelope in the great comet of 1811, exceeded at one time 27,000 miles. And finally, while the analogy of comets to planets is acknowledged in reference to their orbital motion, it is evident that the general phenomena of comets are quite dissimilar. Describing, for the most part, orbits of great eccentricity, some of them moving nearly at right angles with the ecliptic, and not a few directly contrary to the order of the signs of the zodiac, the assumption of a chemical discrepancy between the envelope of a comet and planetary atmosphere, would not be an unreasonable one, and a very slight change in the constituents of the earth's atmosphere, it it is well known, would greatly affect its refractive properties. According to the experiments of Biot, hydrogen gas has six times the refractive power of atmospheric air. In view of these circumstances, the fact that the planets have no tails, and that some *comets* have not this appendage, presents no objection to the theory which I have ventured to suggest.

The final objection offered by the writer, (though others he thinks might be adduced,) is the plurality of tails of the comet of 1744, and the secondary tail of the comet of 1823, and that of 1835. In reference to the comet of 1744, I have no doubt of its plurality of tails, though great allowance is to be made for exaggerated description, as well as optical illusion. The great comet of 1811 was at one time so situated relatively to the earth and sun, that the tail had somewhat the appearance of a fan, and this was the distinguishing feature of the comet of 1744, and the testimony is worthy of credence, that there were several dark zones diverging from the envelope to the extremity of the tail, giving to the whole an appearance of a plurality or an assemblage of tails. The comet of 1769 was also accompanied with a plurality of tails, a particular description of which is given by Messier. To reconcile this with my theory, is only to assume that the envelope is not perfectly homogeneous, an assumption abundantly confirmed by observation. The account given by Scroeter of the comet of 1799 and 1807, of occasional obscurity in the head of the comet, is a striking circumstance in proof of cloudy regions, and this is the explanation given by that writer. But I do not rely on these facts only for an explanation of the eccentricities of the comet of 1744. There are other and more direct causes of the phenomena. This comet at its perihelion approached so near the sun that it became very brilliant, and was moreover accompanied by three distinct envelopes, a condition favorable, it must be acknowledged, to the multiplication of tails, especially when we notice that the ratio is such as to produce the number usually assigned, each beam of light being numbered as a tail. The diversity of circumstances exhibited in the heads of different comets, renders it rather a matter of surprise that so great a uniformity should prevail in the general circumstances of the tails.

We come next to the consideration of another and a distinct class of phenomena, that of the secondary tail, or what Prof. Joslin denominates the "supernumerary tail," distinguishable in the comets of 1823 and 1835. The former was noticed by Prof. Biela, at Prague, and President Day, of Yale College, and by them represented as forming an angle of 178° with the primary tail. The latter was noticed by many observers in this country at various angles with the primary tail, a singular discrepancy prevailing in the various published accounts. Of this extraordinary appearance in the comet of 1823, I have only to express my conviction, not having myself seen it, that it proceeded from the same cause that produced the same phenomenon in the comet of 1835, which was most manifestly the image of the true tail of the comet, projected on the spherical surface of the envelope, visible only under fixed angles, and changing its aspect and position with the relative change in the position of the three bodies, affected also by fluctuations in the comet's envelope. So faithful was the delineation, that the brighter borders of the tail gave to the reflected image the form of a sector.

Our writer having denounced all theories as equally unsatisfactory, recalls the expression, and acknowledges the theory of Dr. Hamilton, of Dublin, to "approach nearer the truth than any with which he is acquainted."

The theory of Hamilton supposed the tails of comets and the Aurora Borealis to be kindred effects of electricity. In support of this theory, the writer adduced a remark of Halley, "that the streams of light so much resemble the long tails of comets, that at *first* sight they might well be taken for such;" and as a further confirmation of this theory, introduces the following quotation from Prof. Vince's System of Astronomy, viz. "The comet of 1607 appeared to shoot out at the end of its tail. Le P. Cysat remarked the undulations of the tail of the comet in 1618. Hevelius observed the same in the tails of the comets in 1652 and 1661. M. Pingre took notice of the same appearance in the comet of 1769."

That the streamers of the Aurora, to the popular gaze, resemble the tails of comets, is very evident; and there ends the affinity. As well might the resemblance of stars to planets be adduced as proof of their identity. The apparent agitation in the light of a comet's tail, extends through its whole length, from fifty to one hundred millions of miles, in a single second of time. Now this fact is entirely incompatible with the established and well known rate of the velocity of light, which gives several seconds of time to its transit through a few millions of miles. This shooting of light is without question to be attributed to fluctuations in our own atmosphere, and is merely another form of the twinkling of the stars. The successive changes in the planet Mercury, when seen by the naked eye, in a clear and bright twilight, present analogous phenomena. The star Capella, when near the northern horizon, is often noticed to change from the first to the fourth magnitude in regular and successive periods of nearly a second's duration. "Concerning the sudden and uncertain fluctuations of the tails," says Newton, "I here say nothing, because they arise from the obscuring vapors and changes in our atmosphere." An additional proof of this, is the fact that these streaming appearances are not to any extent visible except at low altitudes. In the cases alluded to by Prof. Vince, two, certainly, could never have been seen by the observers in their own country at a high altitude. The others I have not investigated.

Equally unsound is the idea that electricity has any agency in the matter. In reference to the tails of comets, there is not the slightest evidence of electrical action, "and those theories," says an ingenious writer, "which attribute this phenomenon of the Aurora to electricity, are met by the following unanswerable objections. The electric fluid never accumulates in visible cohesive masses; it is always dispersed through the earth and air, and its tendency is to remain in equilibrio, or nearly so, unless when collected by some medium different from the atmosphere, as in thunder clouds. The electric fluid never undulates or waves to and fro in sinuous curves and motions, nor does it settle in banks of steady light, or remain at once luminous and stationary, in any form in the pure air."*

So much for the theory of Hamilton, and the reasoning of our author, whose conjectures must be established before they can be entitled to the character of objections. There are moreover some difficulties which have presented themselves to my own mind, and may also have been noticed by others. Thus, one would suppose that the bending of the tail towards the region which the comet is leaving, might be more than adequate to answer the end of aberration; but in estimating this, the position of the tail relative to the observer, as well as its length, must be taken into the account. When the tail lies oblique to the line of vision, the extremity may be many millions of miles more remote than the nucleus, and some minutes of time may elapse after the arrival of the light from the nucleus, before that from the remoter parts of the tail reaches the earth; hence the interval during which the comet moves on in its course, is very much augmented, and the result is a corresponding increase of curvature in the tail.

Again, there has sometimes been observed a general obliquity of the tail to the prolongation of the radius vector of the comet, when near its perihelion, amounting to some degrees. When we consider the great difficulty of obtaining a correct measure of this deviation, arising from the peculiar circumstances under which the comet is often seen when near its perihelion, this difficulty also vanishes. In the first place, when these angles have been measured, the unerring laws of perspective seem to have been wholly disregarded. The unequal effect of refraction also upon the nucleus and the extremity of the tail when near the horizon and oblique to it, an effect of no small consequence, has been subject to similar neglect. In the second place, very many of the visible comets on which observations have been made when near their perihelia, have been visible only when near the horizon, from the very fact of their proximity to the sun, and like other heavenly bodies, have been occasionally subjected to distortion beyond the ordinary effect of refraction, rendering accurate measurement altogether impracticable. Indeed, the whole train of observations on the tails of comets, seems to have been made with little or no reference to the ordinary influence of the

* See this Journal, Vol. xix, No. 2.

established laws of nature, as if a mystical or spiritual nature were unreservedly acknowledged to belong to them. In early ages, it was in keeping with the prevailing superstition of the times to speak of a comet, that "it came out of an opening in the heavens, with blue feet like a dragon, and a head covered with snakes; in its length it was a bloody color, inclining to saffron. From the top of its train appeared a bended arm, in the hand whereof was a huge sword, in the instant posture of striking. At the point of the sword was a star. From the star proceeded dusky rays, like a hairy tail; on the side of them, other rays like javelins or lesser swords, as if imbrued in blood; between which appeared human faces of the color of blackish clouds, with rough hair and beards." But who would believe that within twelve years, a work has been published in England, the author of which traced so direct a connection between the motion of the comet of 1811 and the military movements of Napoleon, that he denounced all persons that denied to comets the character of special messengers from Heaven, as insulters of Divine Wisdom.*

The several causes which I have adduced in explanation of the deviation of the tail from a direction exactly opposite to the sun, will be deemed, I think, a sufficient illustration of the phenomenon; indeed, recent writers have scarcely alluded to the circumstance. "From the head," says the younger Herschel, "and in a direction opposite to that in which the sun is situated from the comet, appear to diverge two streams of light," &c.† "The tails of comets," says Olmsted, "extend in a direct line from the sun, though they are usually more or less curved."‡

I think it will be conceded, that if the tails of comets consist not of matter foreign to the medium in which they move, the theory which I have advanced must be true; at any rate, that the tails of comets are but augmented solar light. Let us then institute an inquiry relative to their materiality. The period has long gone by since a doubt has existed in the minds of astronomers on the subject of *Universal Gravitation.* Discovered by Newton, and demonstrated by himself and Laplace, it is no longer an hypothesis, or a mere theory; it is truth, sublime and immutable,—not

* Milne's Prize Essay, p. 181. † Treatise on Ast., p. 284.

‡ Introduction to Astronomy, p. 233.

limited to the planetary system, but manifest also in the sidereal regions, affecting every particle of matter in the whole amplitude of nature. What, then, exempts the tail of a comet from its influence? Where, in these immensely extended trains of attenuated *matter*, if they are such, is the effect of Saturn's or of Jupiter's attraction, to say nothing of the smaller bodies of the system among which they are so majestically sweeping? Where is that sinuous form which would necessarily result from this unequal and inevitable action? If any where, it has escaped my research as well as observation; the solitary and trifling peculiarity noticed at one period in the extremity of the tail of the comet of 1769, cannot be deemed an exception; and all reasonings on this subject, having matter for their basis, are alike futile. Thus, the theory of Sir Wm. Herschel, which supposed that the solar heat consolidated the tail and envelope on the surface of the nucleus—a theory supposed by Milne to be completely established by the relative appearance and magnitude of the comet of 1811, was as completely overthrown by the appearance and magnitude of Halley's comet in 1835. Indeed, to suppose for a moment that these immense images, so to speak, consist of matter, requires a credulity equal to that which gave credence to the primum mobile and cœlum empyrium of Ptolemy. And if they are not matter, the conclusion is irresistible that they can be no other than the solar beams augmented by the refractive power of the envelope, and manifested to our vision by the medium on which they fall; a theory not less plausible for the explanation which it affords to the general phenomena of these cometary appendages, than for the great simplicity which distinguishes it. This, then, is the *ignis fatuus*, which, in the imagination of men, has given to the sun a blow so formidable as to detach from its surface the world we inhabit, and to that world in its turn, a shock so terrible, that mountains and rocks have been rent asunder, burying indiscriminately in the ruins, animals originally the most remote from each other,—and no marvel so long as a wand of such enormous magnitude was admitted to be material. I trust, however, that a careful and a candid consideration of this interesting subject, will result in the conviction that the tail of a comet is a mere sunbeam, as harmless as that which, by suspended dust, becomes visible from the puncture in the ceiling.

Nantucket, 11th mo. 4th, 1840.

Art. VI.—*Notice of a Locality of Zeolites, &c., at Bergen, Bergen County, New Jersey;* by William Oland Bourne, of New York.

Bergen Hill is the southern extremity of that long perpendicular ledge of greenstone rocks, which, rising to a considerable elevation on the western side of the Hudson river, is known as the Palisadoes, and occupies a large section of that part of the country. The formation here is similar to that at Paterson, from which the datholite, &c. were obtained some years since. Dr. Beck, while engaged in surveying Rockland county, N. Y., observed the minerals of the zeolite family at a number of localities, and mentions one at Tappan Slote, from which he obtained stellite, apophyllite, stilbite, &c., inferior, however, to the New Jersey minerals in beauty, although "they are sufficiently well characterized."

In the early part of 1832, the New Jersey Rail Road Company began their excavations at Bergen Hill, which, however, at first revealed nothing to attract the attention of mineralogists, as the principal veins occur in the middle of the cut, which is levelled to about thirty feet from the surface in its deepest part, and is from twenty to thirty feet wide at the bottom. In numbering the localities, I have begun at the end which is entered on proceeding from Jersey City, and about two miles from the ferry.*

My first visit to this place was on September 6th, 1837, and having repeatedly visited it since, I have reason to believe that the collection in my possession is more extensive than any other from this locality, and I shall accordingly make out my catalogue of the minerals of this region from my own suite of specimens.

The first locality, or No. 1, on the south side of the cut, and about one hundred yards from the end, is a vein of carb. lime, with which stilbite is associated, chiefly coating cavities of the limestone. It is about an inch and a half in thickness, and runs up the side of the cliff, but is so imbedded as to defy any attempt to remove it with the hammer and chisel. That part from which the specimens were taken is low, and partly covered with stones and loose soil, and was completely worked out.

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* The numbers refer merely to the order of description, and not to any guide-marks on the route.

No. 2, on the north side, is a continuation of this vein, as far as can be judged from its direction and inclination, and is perfectly similar in its character, but in this place is larger, and has furnished several minerals which I could not find in the other, viz. brilliant crystals of iron pyrites, heulandite, laumonite, and several forms of calc-spar. The finest specimen of the stilbite of this locality was taken from this vein. It is a cavity in the carb. lime, finely crystallized, entirely coated with stilbite, which has crystals of iron pyrites scattered over its surface, forming a beautiful specimen of about five inches in depth, by two or two and a half broad.

No. 3, on the south side, is a vein of carb. lime with prehnite, of which only one small specimen could be obtained.

No. 4, on the same side, and a few feet beyond the bridge which overhangs the rail-road, is a cavity which did contain epistilbite, (?) and from which a number of specimens have been taken, some of which are very fine. A blast was made, and the whole effectually removed, scarce a trace being left to denote the presence of the mineral. A vein of calc-spar runs up the cliff, and, at the bottom, covered with the soil, a specimen of the spar, in large rhombs, was obtained. It is sometimes associated, on the same mass, with the epistilbite, the latter in minute crystals covering the spar.

No. 5, almost opposite, is a large vein of calc-spar, from which handsome specimens have been obtained. Besides several of the common forms, I found it in thin crystalline tables. Very minute crystals of iron pyrites are found on some of these specimens.

No. 6, just below No. 5, appears to have been occupied by veins of heulandite running along the greenstone, but which had all been broken up and carried away with the exception of the few specimens which we found. This place and the one before mentioned, are the only localities known to furnish this mineral.

No. 7, which is a short distance beyond, is a vein of soft, earthy matter, through which mesotype (?) is disseminated. Higher up in the cliff, the same vein furnishes stilbite—rather indifferent however.

No. 8, on the same side of the cut, is a vein of calc-spar, from which several finely crystallized specimens have been procured. It is in the form of large rhombs. A few specimens of very good datholite were also procured from this vein.

No. 9, on the north side of the cut, about ten or twelve feet from the ground, is a spot furnishing several species. They occur in veins of from half an inch to an inch in thickness, and in the following manner:

1. Analcime and natrolite.
2. Datholite, analcime, and natrolite.
3. Apophyllite, primary and secondary forms, stilbite, and natrolite.

As the rock is very hard, and not to be reached without standing on a ladder, it was difficult to obtain even a few small specimens.

No. 10, on the south side, is a vein of Thomsonite, about an inch thick in the best part. It is lost toward the bottom, and the part from which the specimens were taken is about twelve feet from the ground.

No. 11, a few steps farther in advance, on the same side of the road, at eight feet from its level, is a vein about three inches thick, which gradually decreases in size towards the top of the cliff. Five minerals are found here associated in the same mass: apophyllite, datholite, analcime, natrolite, and a little Thomsonite, with carb. lime in handsome rhombs. All of these minerals except the Thomsonite are crystallized, and are of uncommon perfection and lustre.

A specimen of apophyllite, taken from this vein, has several crystals of an inch in diameter upon it; and another piece has a single crystal of an inch and a half in diameter extremely perfect, except where it is set in the gangue on two or three of its faces; another specimen shows several faces of a crystal two inches in diameter.

No. 12, a few feet beyond No. 11, was a vein of Thomsonite, prehnite, and mesotype. Several fine specimens were obtained from it, one of which presents a surface about one foot square. The specimen which matched with it was broken into three pieces in splitting the rock, but they are of very good size. Associated with the three minerals just named, are some very fine datholite, and a little hog-tooth spar. This vein was exhausted.

No. 13, on the north side, a short distance from No. 10, is a vein of datholite, which is uncommonly beautiful. It is about three inches thick at twelve or fourteen feet from the ground, and is lost towards both the top and bottom of the cliff. Associated with the datholite is apophyllite, and a small quantity of natrolite. The apophyllite is of a very fine quality, both as regards crystallization and lustre. A specimen or two of pseudomorphous crystals was also obtained here, supposed to be all that were found at Bergen Hill, composed of apophyllite and the black matter which occurs in some of the veins of the greenstone. The crystals have the regular form of the apophyllite.

No. 14, farther on, same side of the cut, is a vein of carb. lime, which is unworthy of notice but for the primary form of apophyllite, which is found about six feet from the top of the cliff. From the appearance of this vein, however, I think that a specimen in my collection was thrown out of it. It is about three or four inches thick, and eight long, presenting a fine surface, almost entire, of the secondary form of apophyllite.

All of these localities, with but few exceptions, were examined by standing on a ladder which was carried about for the purpose, and it is possible, though not probable, that further scrutiny will develope others.

Most of the specimens of this place have been found among the heaps of loose stones which lie on the hill near the road, as well as on the wharf at Jersey City, which, however, is now filled in, and all attempts to obtain any more from the latter source will be vain. Datholite I believe to have been the most common; massive apophyllite, from one to two inches thick; Thomsonite, commonly half an inch thick, in veins—some an inch, and a few specimens in my possession, two inches thick. A few specimens only of stilbite have been found loose, and the quantity obtained from its localities was not very great. All the epistilbite was procured at No. 4, except when associated with datholite, and, in these cases, the specimens are of great beauty. Some of them are of large size, presenting surfaces of from four to six inches square. The natrolite is quite rare, a few specimens only having been taken from the cliff, at the localities before described, with the exception of one which was found loose.

Brown Thomsonite, in fine masses, some of it two inches thick, and well crystallized, is exhausted—we could not find it in place, after a fruitless search.

The chabasie of this locality is very inferior, and none of the crystals are perfect except very small ones.

One of the loose masses had datholite, stilbite, analcime, chabasie, apophyllite, (primary form,) and calc-spar upon it, forming an unusual association.

Prehnite generally accompanies the Thomsonite, and sometimes the datholite. A vein of Thomsonite with this mineral occurs between Nos. 9 and 10, but it is difficult to procure any thing from it. A specimen of prehnite and Thomsonite, presenting a surface about three or four inches square, found loose, is of great beauty—the latter in long, transparent crystals, radiating through the former.

Blende, imbedded in apophyllite, has been obtained here—the quantity very small; colors green and red. Galena, in small crystals, of which only a specimen or two was found.

Among the loose bowlders to be met with in the soil where the excavations were made, was one from which some good specimens of idocrase were taken.

Scolecite, I think, may also be included in the list of the minerals of this locality, a specimen in my collection answering the description by Dana in its external characters.

Dr. Beck, in his last report on the mineralogy of New York, states that he visited Bergen Hill, and found stellite there. He also appends to his report Dr. Thomson's description of the mineral. Since reading it, I have re-examined my own collection, and have little doubt that I had previously confounded the stellite with Thomsonite.

The greenstone ridge, in which the veins just described occur, is two miles from Jersey City, the mile post being placed near the middle of the cut. This is the principal one of three ridges which are covered with soil, although they are in some places denuded, and the valleys between them filled with bowlders and sand, which, doubtless, have been deposited there by diluvial action; but I leave these interesting speculations for others.

Art. VII.—*Notice of the Geological Survey of the State of New York, presented to the Legislature, Jan.* 24, 1840; by Oliver P. Hubbard, M. D., Prof. of Chemistry, Mineralogy and Geology in Dartmouth College, N. H.

The steady progress which has attended the geological survey of New York, must be gratifying to every friend of science and of popular improvement. These annual reports are intended only as evidence to the proper authorities of the State of the advance of the work, and to convey as early as possible, hints of valuable resources, that the people may avail themselves of them before the completion of the survey ; but the digest of all the facts, and the scientific reasoning and deductions based on them, will form the crown of the labors of the geologists, to which, no doubt, they may look forward with satisfaction. As to time, this survey was projected upon the scale of *four years*, to the astonishment of many sensible individuals, who supposed a geologist would only have to establish himself, for a few days, in a comfortable hotel near the center of a county, and the inhabitants, having received notice some time previous of his sojourn there at a given time, would all come in, bringing their tribute of rocks, minerals and soils, and the work for a county would thus be completed in a very short time, and for a small expense, very much as a landlord would do with his tenants on quarter day. The estimated expense of the undertaking was as little understood as the time required, and both mistakes arose manifestly from entire ignorance or misconception of the nature and objects of the work. We may point such persons to the "Silurian System," by Murchison, a work that occupied him some seven or eight years, aided by the suggestions and observations of many distinguished men, in the survey of a region far less in extent (although its geology is more complicated) than the State of New York; and we may refer such individuals to Buckland's Bridgewater Treatise, upon the plates of which alone we understand the author expended the whole £1000 he received from the founder of that series of works.

The present report is the last of the *four* annual ones, and the attention of the geologists will now be, of course, directed to the preparation of the final report. Here there is an opportunity for the State to display a just liberality in the execution of the "maps, geological sections and diagrams," in the illustrations of zoology, conchology, botany, &c.; and in the convenient arrangement of the various cabinets of natural history, that will greatly favor the just estimation of scientific labors in our country; and we expect from these State collections, that are already formed, and will be made, a considerable influence in favor of the study of natural science.

Dr. De Kay's report consists of a "Catalogue of the Animals belonging to the State of New York, as far as they have been figured and described," and a "Report" on the geographical position of the State, which is included between the ocean and the great lakes, and intimately connected with the Mississippi valley on the one side, as it is with the mountainous districts of the Eastern States on the other. Dr. De Kay observes, that with a variety of soil, temperature and elevation, favorable to the development of organic forms, he "finds the Fauna of the State embracing the great bulk of the zoology of the United States," "in which the geographic range of species is conceded to be of greater extent than in Europe."

The classification in the "Regne Animal of Cuvier," with authorized modifications, as by C. L. Bonaparte and Audubon, in ornithology, has been adopted for the final reports, followed by a description of the species, with a notice of their habits, geographic range, &c. If Dr. De Kay is permitted to complete his illustrations in as good style as some specimens we once had the pleasure of seeing in his hands, there is reason to expect a beautiful addition to the works in this department.

Dr. Beck mentions the occurrence of plumbago in the Fishkill mountains, and a second locality of Gibbsite in an iron mine at Unionvale.

He reports "specimens of oolite, at Saratoga, similar in character to the celebrated English Bath or Portland stone." In the final report we expect to be assured that this rock, with the mineral structure of oolite but without its organic remains, does not belong to the oolite formation which forms so remarkable a feature in the geology of England, and that like all other specimens of that structure found in this country, it indicates a form of rock not rare out of that series, and affords no evidence of the existence of a geological equivalent to the oolite of Europe.

The similarity in the geological associations of minerals of the same kind, in the northern and southern portions, is, in many cases, very great; in other cases there is no resemblance.

The "magnetic oxide of iron" is an example of the former kind. It is found apparently in beds following the line of direction and of dip where the rocks are stratified, although in some cases presenting a variation, and cutting off a stratum at variable distances.

The specular oxide of iron, in the northern counties, is connected with sandstone,—"the cavities are filled with beautiful crystals of quartz," with very short prisms, and sometimes only double hexahedral pyramids;—the deposits "are flanked by beds of limestone, and the hematitic iron ore of the south usually lies near the junction of the limestone with the talcose slate formation."

The ores of *lead* are found in almost all the series of New York rocks. The galena, in the hornblendic gneiss of Rossie, is the most remarkable deposit. A large group of crystals, in my own cabinet, from this place, contains one which is three inches across, —all are truncated on their solid angles, and some seem almost octahedral. "Calcareous spar, in the most diversified and beautiful forms, constitutes the principal matrix of the ore, and white fluor spar, its frequent associate, is of rare occurrence."

Dr. Beck remarks, that the soil, in the vicinity of the serpentine rocks, seems not to be injuriously affected by the presence of magnesia, according to a somewhat general impression that has been entertained concerning the effect produced by this earth, when existing in soil. As additional evidence in favor of magnesia as a stimulant to vegetation, the limestone of Rochester and Lockport, and all the water limes that have been analyzed, contain from twenty to thirty parts of it, in the form of a carbonate, and "the soils in their immediate vicinity are among the most fertile in the State." An instance is within my own observation, of the use of the mineral dolomite, obtained at Fairlee, Vt., twelve miles above Hanover, derived from large veins in the older slate rocks, which was ground as plaster, and used by farmers upon their land, side by side with gypsum, and the improvement of the crop, above the general average in the field, was the same in both cases.

The mineralogy of each county in the State is given, in which department, for the beauty, size, number, and rarity of the minerals, Orange and St. Lawrence counties are pre-eminent. Most of them have been previously noticed. One crystal of phosphate of lime, from the latter county, weighs eighteen pounds. The varieties of calcareous spar, found with the galena of Rossie, are very numerous, associated with cubes and dodecahedra of iron pyrites and fluor spar, in crystals of the octahedron and cubo-octahedron; and splendid specimens of sulphate of strontian are also found.

Dr. Beck describes Allanite, from Warwick, Orange county, its first occurrence in the United States, "and Cacoxenite in an iron mine in Antwerp, Jefferson county, heretofore found only in the iron mines at Hrbeck, in Bohemia, and is chiefly composed of phosphoric acid and peroxide of iron."

The analysis of Eupyrchroite, described by Dr. Emmons in the second annual report, proves it to be a phosphate of lime 92.85, with oxide of iron 5.26 and a trace of fluoric acid; and Rensselaerite is "pyroxenic steatite;" its crystalline form is the oblique rhombic prism, M on M 94° and 86°, P on M 106° 30′; and resembles the steatitic pyroxenes of Sahla noticed by Beudant, and its composition, 59.75 silica, 32.90 magnesia, is similar to that of steatite.

Dr. Torrey's report on Botany, is the first of importance received from him. He is charged with the collection and preservation of seven sets of each species, and the arrangement and naming of the whole. From the nature of his duties, the assistance of many observers and collectors in various portions of the State, was indispensable, and they seem to have placed at his disposal, with truly scientific liberality, their catalogues and collections, for the purpose of enabling him to make out his own catalogue.

"The whole number of species, indigenous and naturalized, in the State, including the lower orders of the cryptogamia, probably exceeds 2,400. Of the phenogamous, or flowering plants, 1,350 species have been found; of ferns and plants allied to them, 53 species; of the mosses, 150 species; of Hepaticæ and Characeæ, 30 species; lichens, more than 150; and fungi, at least 300. Of the flowering plants, 277 are trees or shrubs; 150 are reputed to possess medicinal properties; 250 are ornamental herbaceous species; and 140 are plants whieh have been introduced from other countries, and are now naturalized in our soil. Of proper grasses, our Flora contains 150 species, twenty four of which are of foreign origin. In the nearly allied tribe of the sedges, there are 140 species, more than half of which belong to the genus Carex."

The natural method is employed in the catalogue, with the synonyms, locality, time of flowering, &c.; and the final report will contain full descriptions of all these plants, and of others that before its publication may be discovered and added to this catalogue of 81 pages, 8vo.

Mr. Conrad's report is short, and occupied in detailing the progress he has made in identifying the New York strata as equivalents of Murchison's "Silurian System." The view he took of these in his first report, has been completely confirmed by more careful comparison of the organic remains; and it is impossible, when we consider the obscurity and confusion that have prevailed concerning these formations, and the impediments that existed to a proper understanding of them, not to partake of the enthusiasm of the palæontologist, as he approaches the conclusion of his labors, and the gratification he expresses that "the legislature of New York has had the liberality to cause the organic remains of the various formations to be figured and described in the final report of the geologists. The plan contemplated in describing them, is that of a stratagraphical, or grouping of all the organic remains in a particular series of strata, referable to one geological epoch; and a student may, with the book before him in the field, identify at once the rocks he desires to investigate."

"The series in New York is far more complete than that of Wales described by Murchison, the formations pre-eminently characterized by their organic contents being three times the number of those illustrated in the Silurian System."

The comparison of the two series has resulted in identifying the "Trenton *limestone*" with the "Caradoc *sandstone*," the Llandeilo flags not being represented here,—showing the importance of organic remains, in the absence of lithological resemblance.

The "Salmon river sandstones and shales," possess a distinct and peculiar group of fossils, and are not represented in the Silurian System. The "Niagara sandstone" contains fossil remains peculiar to it, and is characterized in New York, Pennsylvania and Virginia, by the splendid Fucoides Harlani. Although this is not found in Wales, "some of the fossils in the strata above it are characteristic of the upper parts of the Caradoc sandstone;" and all these Mr. Conrad considers its equivalent. "The Wenlock shale is identical with the shales at Rochester, which abound in the Asaphus limulurus of Green, (A. longicaudatus, Murch.)"

"The Wenlock limestone immediately succeeds the Wenlock shale in Wales, but the two formations are here separated by the following rocks, each of considerable thickness, and with distinct fossil groups. 1. Lockport limestone. 2. Gypseous shales. 3. Water lime series. Over the latter we find a blue sub-crystalline limestone, and then a gray shaly limestone, which together appear to represent the Wenlock formation, both in fossils and mineral character."

"The lower Ludlow rock has its equivalent in a grit above the Oriskany sandstone."

The full account of this extended series will prove of great value in investigating the formations of our northwestern States. In general, the reports of their surveys present but little that is available to a scientific classification. The lithological character of the rocks may be obvious, and easily interpreted; but it is clearly impossible to decide upon their geological relations or equivalent character, especially when comparing formations of distant countries, without a particular knowledge of their organic remains. The conditions that govern the development and existence of organic beings, are so complicated, and, if we may so say, of an order so much higher, that their coincidence in different localities is far more remarkable than that of those producing similar rocks; and of course the evidence based upon the resemblance or dissimilarity of the fossils, should be more weighty than that derived from these qualities of a rock.

Mr. Mather's survey of the first district, has developed "the *Catskill mountain series*, consisting of coarse and fine grits, grayish, greenish, and various shades of red and brown, which lie thick bedded with water lines of deposition, strongly marked where a cross fracture exhibits the structure; conglomerates, of various degrees of coarseness, grayish, greenish, and red; slaty sandstones, with slates and shales of various colors, red, green, spotted, gray and black. Testacea are the principal fossils of the lower, and plants of the upper portion of the series, with seams and layers of pure anthracite;" and probably all of them are below the old red sandstone; and they have below them the *Helderberg limestone group*, No. 7, of Mr. Conrad's synopsis, in his second report, which "embraces a series of limestones, with subordinate beds of shales, slates, and silicious grits. It skirts the group of rocks last described, in a parallel zone, and underlies them, it is supposed, through their whole extent."

"The *Shawangunk grit*, next below, varies from a conglomerate to a fine grained grit rock; it is almost entirely silicious, and generally white or light gray in color, with one bed at the upper part that is red. The mountain on which this rock abounds, has taken its name from the predominant color of the rock—the word Shawangunk (Shongum) meaning, it is said, in the language of the aborigines of the country, *white rocks*. This rock, which is largely developed in Pennsylvania and New Jersey, is much less so in New York, and extends, in an almost unbroken range, from the New Jersey line, on the top of the Shawangunk mountain, to Rosendale, near Kingston, a distance of forty three miles, where it disappears beneath the water limestone and tertiary deposits of the Hudson valley. On the higher parts of the Shawangunk mountain, it generally lies in nearly horizontal strata, often thick bedded, and in mural escarpments, of broken ends of the strata, thirty to two hundred feet high; on the eastern face of the mountain the strata have a high dip to the east southeast, and on the western side the dip is almost uniformly to the west northwest and northwest, in some places from 30° to 60°. Two systems of fractures, more or less coincident with and transverse to the direction, are found; and where the elevatory movement has been along the *latter*, the dip is N. N. E. or S. S. W; where the upheave has been *longitudinal*, the dip is W. N. W. or E. S. E. The same general principles hold true in the rocks lying lower in the series, as the Hudson slate group, and the rocks of the Highlands. Most of the streams follow these lines of fracture, changing from one to the other, to produce many of their changes of direction. Some of these lines of fault have been traced for many miles across mountains and valleys.

"In the rocks thus described, there is evidence of at least three elevatory movements, viz. one (at least) before the deposition of the Shawangunk grit strata; another after the deposition of this and the Helderberg and Catskill series, and before the tertiary epoch; and another since that period. The *Hudson slate group* consists of a series of slates, shales, grits and limestones, with silicious and calcareous breccias, and hypogene and Plutonic rocks, which correspond in many respects with the "Cambrian system" of Prof. Sedgwick, and occupies most of the country between the Highlands on the southeast and the Shawangunk mountains on the northwest, and forms the mass of the latter mountains below the Shawangunk grit. From Kingston, it ranges along the western bank of the Hudson, to Albany, (ninety miles,) underlying the superincumbent rocks, unconformably with few exceptions. Its range on the left bank of the Hudson, as far as examined, is detailed in the second annual report. Its fossils, observed this year, are a few impressions of shells, and some Fucoides, or Graptolites, from the black shale below the Shawangunk grit, from 500 to 700 feet above the valley."

Prof. Emmons presents in his report a notice of much interest, in relation to the iron ores of his district. Those of Essex county, at McIntyre, occur in vast abundance in the hypersthene rock; they are also found in the other primary rocks. They belong to one variety, the octahedral or magnetic oxide, and occur in veins of great extent.

The peculiar connexion of trap dikes with these veins suggests to Prof. Emmons an igneous hypothesis as to the origin of the ore.

These veins in Arnold Hill, are crossed by a greenstone dike, ten feet wide, which dislocates one of them four feet, and they run north and south, making an angle with the direction of the rock and red granite, which is northeast and southwest. The Palmer vein is cut by four dikes; one of them is fourteen feet wide, and is traceable on the surface half a mile. This dike being pierced, a vein of ore thirty five feet wide was found, in close contact with the dike and cleaving readily from it.

The Winter ore has been cut through by nine dikes.

The amount of the several veins in the vicinity of Clintonville is one hundred and thirty six feet. The ores in the Sandford mine, town of Newcomb, are in the hypersthene rock, and it would *appear*, from the minute survey and description given, that this ore is very superior, and the locality possesses advantages that render it more available than any other works of the country.

These ores have been wrought, and the iron made has been submitted to comparative experiments by Prof. Johnson* of Philadelphia, and found to be equal in strength to the best English iron and surpassed only by the Russian.

Prof. Emmons contrasts the position of the specular oxide of iron of Jefferson and St. Lawrence counties, with the magnetic oxide of Essex, and describes the association of the former as follows: "The specular oxide may be (is) found in two geological positions,—in the first it is associated with primary limestone —in the second with gneiss, or some other primary rock beneath, and the Potsdam sandstone above. In addition to the limestone, serpentine is a common associate. It is sometimes in pure separate masses, and in others, it is in intimate mixture and combination—giving in the first instance a spotted, and in the last a mottled appearance to the rock."

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* See this Journal, Vol. xxxvi, p. 94.

The ore "is found in wedge-form masses, which thin out entirely in the downward direction, and the quantity varying from 120 tons to a mass of 500 lbs., which was moveable with a bar, *in place*,"—its connexion with the parent rock having been destroyed by decomposition.

The most abundant variety of specular ore, "occurs of a deep red color, and in red powder, or bright shining scales, which by slight pressure become a red powder." Some of the deposits "are apparently inexhaustible, and others are merely a mass of red earth in which there are a few lumps of hard ore." "Their position is confined to the upper portion of the primary strata, and lower layers of the Potsdam sandstone. It is rather remarkable that this rock, so generally connected with this deep red ore, is not as highly colored throughout as it is in some places, although generally it is white, or pale red, with a tinge of brown or yellow."

From the observations made by Prof. Emmons in some of these mines, he suggests that the ore which appears in some cases as "a bed lying between the primitive rocks, and the oldest of the sandstones," may be "in veins, being the upward extension into the sandstone from the primary mass." In support of this view, he mentions the following facts connected with the occurrence of this ore: "1. There are numerous places where this ore has no other connexion than with the primary. 2. There are strong reasons to suppose that at these localities the sandstone has been removed, and that they were formerly in the same geological relations as the range in which the Parish and Kearney beds are now found. There are every where abraded surfaces and fractured strata, and it appears that the sandstone was once continuous over wider areas than it now occupies, as we find its remains as far east as the specular iron is known to occur. According to this view the sandstone, together with the red ore, has been removed, and according to well known facts, the whole must have been carried south; and what do we find in that direction? Not only beds of red oxide of iron, mixed it is true with argillaceous matter, but also silicious rocks, the red sandstone, and the gray band of Prof. Eaton, &c., in connexion with this argillaceous oxide."*

* See Vol. XXXIX, pp. 104, 105, Am. Journal.

"Could we establish the connexion, now supposed, between the rocks of St. Lawrence and Jefferson, and those of the counties south, it would be an important link in the chain of facts connecting the origin of those rocks, the relative period of deposits, the slope of the country, the direction of the valleys, in fine, it would be the gathering up of a mass of the history of ancient times, of the most interesting character and bearing generally on the geology of the state."

Mr. Vanuxem's report is chiefly of Lewis county, with a more particular notice of the rocks found in his district, than he has before given.

The geologists of the third and fourth districts, have made frequent reference to the agency of igneous causes, to account for many of the phenomena observed in their field of observation. Among these, none are more curious than the following, described by Mr. Vanuxem.

Speaking of the rock at Middleville, near Little Falls, which there "rests immediately upon the primary," he says:—"The 'calciferous sandrock' in many localities abounds with cavities large and small, often containing rock crystals, and small quantities of anthracite coal. Frequently the large cavities, which are in part filled with crystals, have a covering of coal, which is flattened or depressed towards the center, showing that the coal was in a soft or yielding state. In other cavities, the coal is sometimes found in the form of drops or buttons. These facts show that the coal was once bituminous, and has by heat been changed to anthracite. In some of the cavities, the whole of the crystals, amounting to a peck or more, have their angles and edges rounded from friction, either from water having entered with a circular motion, or that a motion of the kind had originated from either vapor or gas. That this rounding of the angles and edges of the crystals was anterior to the solidification of the coaly matter, is evident from the fact of the anthracite covering in the manner above mentioned, the crystals which had been rounded by rubbing one against another."

The configuration of the surface of Lewis county, is worthy of remark. The Black river, which enters it on the southeast, runs northwest, drains the whole county, divides it into two nearly equal portions, and is the line of separation between the primary rocks on the east, with its barren soil and extensive diluvium of sand and rocks, and the rich limestone, slate, and shale lands to the west, which are well known as exceedingly fertile. This portion of the county is celebrated for its herds of cattle and horses, and its production of wheat. The difficulties heretofore experienced for want of a ready communication with the large markets, has prevented it from advancing as rapidly in wealth and population as other portions of the state, but the construction of the Black river canal, will remove this obstacle to its prosperity; and it is destined to compete successfully with its sister counties on the Erie canal, in its agricultural productions and mineral resources. "The rocks of the county are the *primary*, the *Potsdam sandstone*, the *fucoidal layers*, ('which are interposed betwen the calciferous sandrock and the Mohawk limestone, and are so abundant in the valley of the Mohawk,') the *Mohawk limestone*, (at Boonville, forty feet thick, and quarried for the locks of the canal,) which lies under the bird's-eye limestone, but the latter being absent in Lewis county, the *Trenton limestone* succeeds, increasing in thickness from thirty feet at the Mohawk to three hundred feet, at Copenhagen, generally divided by cracks or fissures, that have a twofold direction; one system being north and south, and the other east and west; the *black slate*, the *Frankfort slate*, and the *shales of Pulaski*. All these stratified rocks except the first two, pursue a uniform north and south direction through the county."

The opinions entertained by the geologist of the fourth district, Mr. Hall, in his report for 1838, p. 291, and in his report of 1840, pp. 393, 394, and 452, 453, concerning the rocks of this portion of the state, their age and relative position in the scale, are quite different from each other. The lithological character of the New York rocks has occasioned doubt and perplexity in the minds of many observers, and the labor expended to resolve these doubts, has heretofore resulted in no clearer view of the case, but served rather to increase the darkness; and where we have compared them with the rocks of foreign countries, according to English or French classifications, the anomalies were found too great to permit our regarding them as the equivalent of either system. Mr. Hall appeared satisfied, however, with the conclusion expressed in his former report, because it rested in part upon the evidence afforded by the "organic remains;" but since then, the same kind of evidence has convinced him that these rocks are "not of the carboniferous," and but slightly of "the old red sandstone groups;" but the *true Silurian*, of Murchison, terminated or capped by the old red sandstone, "*bordering the southern limits of the state, and in Alleghany county (N. Y.) extending north of the line;*" and it appears there upon the Genesee river in a stratum about six inches thick, containing a large proportion of iron. The settlement of the questions that have arisen concerning the geology of New York, must be regarded as of the highest interest to science, and as having removed the greatest obstacle that existed to the successful study of our American geology. Every one may see how unfortunate would have been a difference of opinion on this subject among the geologists in their final report; how much, instead of promoting the cause of science, it would have retarded its progress, had their energy and talent been devoted to the support of conflicting conclusions and opinions. The candor of Mr. Hall in deferring to the new and increased evidence presented by the "Silurian system," is worthy of imitation; and this great extension of that class of rocks, in this country, ascertained and identified solely by comparison with the work of Mr. Murchison, the distinguished pioneer of this geological period, will certainly cause him a noble gratification, while it adds lustre and dignity to his labors.

Art. VIII.—*On the Magnetic Dip in the United States;* by Elias Loomis, Professor of Mathematics and Natural Philosophy in Western Reserve College.

Messrs. Editors—I have read with much interest the remarks by Prof. Locke in the last number of your Journal, and have in consequence been led to review my former magnetic article pub- in Vol. xxxix, p. 41. I have carefully compared all of Prof. Locke's observations with such of my own as have been made in Ohio and Michigan, both those which are given in my former article, and those which I have since made. I have followed the method adopted by Major Sabine in his magnetic survey of Scotland. The first column in the following table gives the stations of observation; the second and third give their latitudes and longitudes, taken from Mitchell's large map of the United States, with the exception of places not shown on that map. The longitudes have all been diminished seven minutes, which by my observations is the error in the assigned longitude of Hudson. Column fourth exhibits the observed dip, reduced to Jan. 1, 1840, by assuming the annual motion to be $-1'.8$. Adopting for the central position lat. 41° 22′, lon. 84° 54′, we obtain the differences of latitude and longitude which furnish us the annexed equations of condition.

Stations.	Latitude.	Longitude.	Dip, Jan. 1, 1840.	Equations of condition.	Diff. of observ'd & comp'd dip.
	° ′	° ′	° ′		′
Louisville,	38 18N.	85 37W.	70 1.7	$1.028=\delta-184x-33.7y$	+17.1
St. Louis,	38 37	90 11	69 30.8	$.513=\delta-165x-247.7y$	+ 2.9
Cincinnati,	39 6	84 23	70 34.8	$1.580=\delta-136x+24.1y$	− 1.8
Dayton,	39 46	84 5	71 19.6	$2.327=\delta-96x+37.7y$	+ 5.0
Springfield,	39 55	83 42	71 24.3	$2.405=\delta-87x+55.2y$	− 1.0
Columbus,	39 57	82 58	71 1.8	$2.030=\delta-85x+88.9y$	−30.6
Urbanna,	40 5	83 39	71 35.8	$2.597=\delta-77x+57.4y$	+ 1.2
Tallmadge,	41 6	81 26	72 50.6	$3.843=\delta-16x+156.7y$	+ 5.7
Windham,	41 15	81 3	73 4.6	$4.077=\delta-7x+173.7y$	+ 9.0
Shalersville,	41 15	81 13	72 57.8	$3.963=\delta-7x+166.2y$	+ 3.4
Streetsboro',	41 15	81 20	72 54.1	$3.902=\delta-7x+160.9y$	+ .5
Hudson,	41 15	81 26	72 50.8	$3.847=\delta-7x+156.4y$	− 2.0
Warren,	41 16	80 49	73 1.9	$4.032=\delta-6x+184.2y$	+ 3.8
Hartford,	41 20	80 34	73 1.0	$4.017=\delta-2x+195.2y$	− 2.4
Bazetta,	41 20	80 45	73 0.9	$4.015=\delta-2x+187.0y$	− 1.2
Aurora,	41 20	81 20	72 56.7	$3.945=\delta-2x+160.7y$	− 1.3
Twinsburgh,	41 20	81 26	72 52.5	$3.875=\delta-2x+156.2y$	− 4.8
Bedford,	41 24	81 32	72 59.3	$3.988=\delta+2x+151.5y$	− .8
Kinsman,	41 28	80 34	73 9.3	$4.155=\delta+6x+194.8y$	− 1.2
Davenport,	41 28	90 35	71 52.9	$2.882=\delta+6x-255.5y$	− 6.7
Sandusky,	41 29	82 40	72 56.6	$3.943=\delta+7x+100.4y$	0.0
Cleveland,	41 30	81 42	73 19.0	$4.317=\delta+8x+143.8y$	+14.7
Maumee,	41 34	83 32	72 47.9	$3.798=\delta+12x+61.4y$	− 7.0
Lost Grove,	41 39	90 9	72 1.9	$3.032=\delta+17x-235.4y$	−10.7
Toledo,	41 41	83 25	73 4.9	$4.082=\delta+19x+66.5y$	+ 2.9
Wapsipinnicon,	41 45	90 23	72 14.4	$3.240=\delta+23x-245.4y$	− 2.0
Monroe,	41 55	83 20	73 31.1	$4.518=\delta+33x+69.9y$	+16.1
Brown Settlement,	42 4	91 2	72 20.9	$3.348=\delta+42x-273.2y$	− 8.1
Farmer's Creek,	42 13	90 23	72 32.7	$3.545=\delta+51x-243.6y$	− 9.0
Ypsilanti,	42 14	83 32	73 16.8	$4.280=\delta+52x+60.7y$	−13.8
Mahoqueta,	42 14	90 57	72 43.1	$3.718=\delta+52x-268.8y$	+ 4.4
Ann Arbor,	42 18	83 37	73 12.7	$4.212=\delta+56x+56.9y$	−20.8
Detroit,	42 19	82 56	73 41.4	$4.690=\delta+57x+87.2y$	+ 2.2
Dubuque,	42 29	90 26	73 4.6	$4.077=\delta+67x-244.8y$	+ 8.7
Mineral Point,	42 52	89 58	73 20.3	$4.338=\delta+90x-222.8y$	+ .4
Blue Mounds,	43 1	89 27	73 40.6	$4.677=\delta+99x-199.6y$	+ 9.1
Prairie du Chien,	43 4	91 0	73 16.3	$4.272=\delta+102x-267.4y$	− 7.3
Madison,	43 5	89 6	74 3.2	$5.053=\delta+103x-184.0y$	+25.6

The preceding equations furnish us, by the method of minimum squares, with the following values: $\delta=3.5747$, $x=+.01491$, $y=+.00262$, and the direction of the isoclinal line is from N. 80° 1′ W. to S. 80° 1′ E. Computing from these data the dip at the several stations, we obtain the differences given in the last column above. When the observed dip is greater than the computed, the sign + is prefixed. Eight of these differences are greater than 10′, four of them belonging to Prof. Locke's observations and the others to mine. They are as follows:

Prof. Locke's.			*Prof. Loomis's.*		
Columbus	−30′.6	−23′	Ann Arbor	−20′.8	−19′
Madison	+25′.6	+27	Monroe	+16′.1	+13
Louisville	+17′.1	+12	Cleveland	+14′.7	+16
Lost Grove	−10′.7	*	Ypsilanti	−13′.8	−15

The numbers in the second columns are the differences given in my former article. The correspondence is certainly as good as could have been expected, considering that the last result is obtained by a comparison of nearly double the number of observations, and by a rigorous computation, while the other results were measured upon a map. At Prairie du Chien the discordance is more considerable. The difference I now find is −7′.3; in my former paper −20′. The discordance is owing in part to the curvature I ascribed to the isoclinal lines, by which most of the observations seemed best represented, though the apparent error of this observation was increased. The differences for the remaining thirty observations are quite moderate, and shew that the hypothesis of parallel straight and equidistant isoclinal lines, is not very much in error.

Let us now compare Prof. Locke's observations in the neighborhood of the Mississippi river with themselves, and see how they accord. The following table is arranged like the preceding, the latitudes and longitudes being as furnished by Prof. Locke. The central position adopted is lat. 42° 0′ N., lon. 90° 10′ W.

Stations.	Latitude.	Longitude.	Dip.	Equations of condition.	Dif. of observ'd & comp'd dip.
	° ′	° ′	° ′		′
St. Louis,	38 36N.	89 36W.	69 31.4	$.523=\delta-204x+26.6y$	+ 3.4
Davenport,	41 30	90 18	71 53.4	$2.890=\delta-30x-6.0y$	− 7.1
Lost Grove,	41 39	90 9	72 2.4	$3.040=\delta-21x+.7y$	− 9.7
Wapsipinnicon,	41 45	90 23	72 14.9	$3.248=\delta-15x-9.7y$	+ 1.7
Brown's Settlem't,	42 4	91 2	72 21.4	$3.357=\delta+4x-38.6y$	+ 2.9
Farmer's Creek,	42 13	90 23	72 33.1	$3.551=\delta+13x-9.6y$	− 7.0
Mahoqueta,	42 14	90 57	72 43.6	$3.727=\delta+14x-34.8y$	+13.8
Dubuque,	42 29	89 56	73 5.	$4.083=\delta+29x+10.3y$	+ .6
Mineral Point,	42 50	89 54	73 20.6	$4.343=\delta+50x+11.7y$	− 4.6
Blue Mounds,	43 1	89 38	73 40.9	$4.681=\delta+61x+23.4y$	− .1
Prairie du Chien,	43 3	90 52	73 16.6	$4.277=\delta+63x-30.7y$	− 2.1
Madison,	43 5	89 6	74 3.5	$5.058=\delta+65x+46.7y$	+ 8.3

These equations being solved in the usual manner, give $x=.01600$, $y=.00745$, $\delta=3.5323$, and the direction of the isoclinal lines is from N. 65° 1′ W. to S. 65° 1′ E. Computing the dip from these data we obtain the differences in the last column above. These differences are much less than those before found, and it seems highly probable that in this vicinity the isoclinal lines make a greater angle with the parallels of latitude than they do in Ohio. Yet the above observations are all embraced within less than two degrees of longitude, and are therefore insufficient to determine with much precision the dependence of the dip upon the longitude. I think it improbable that the inclination should be as great as 24° 59′ according to these observations; yet admitting such to be the case, we still obtain considerable differences between the observed and computed dip. Are these differences to be regarded as errors of observation, or as errors of the hypothesis of parallel, straight and equidistant isoclinal lines? In order to answer this question, it is necessary to consider all the possible sources of error in magnetic observations.

The errors arising from the inclination of the magnetic axis of the needle to the axis of figure, and from inequality in the weight of the arms, as well as the zero error of the graduation, appear to have been provided against in Prof. Locke's mode of observation. That arising from the excentricity of the axis of the needle in relation to the vertical circle on which the readings are made, is not alluded to. This error in my instrument commonly amounts to one or two minutes, and sometimes even to five or more. It is corrected by readings at both extremities of the needle. Prof. Locke makes no mention of having employed this precaution, and his language on page 321, where he says "the dip is determined by eight distinct readings of each needle," would seem to imply that he did not attend to it. With a good instrument, no great error would ordinarily arise from this source, yet it might easily amount to 2′ or 3′.

A more considerable source of error is that arising from the uncertainty of the readings themselves. A dipping needle will seldom come to rest twice in the same position. This arises, not from a change in the direction of the magnetic force, but from friction on the axis of the needle. Prof. Locke's observations exhibit this fact in a striking light. The difference of the readings with the face of the instrument east and west, and in the same position of the needle, is equal to twice the zero error. Now as this error may be assumed to be constant, we obtain by a comparison of the observations eighty eight values of the same element, the accordance of which with each other will enable us to judge of the confidence which may be placed in a single observation. It will be seen that the dip is usually the greatest when the face of the instrument is east. Subtract then the dip observed with the face west from that found with the face east with the same position of the needle. For example, in the first observation 72° 47′ from 72° 5′ gives −42′, and so of the rest. We thus obtain the following table, which exhibits the observed values of twice the zero error.

−42′	+14′	+11′	− 1′	+ 7′	+ 2′	+ 1′	+20′	+11′.5	+ 4′	+ 8′
+19	− 3	+ 3	+ 3	+ 8	+13	− 2	+15	+ 7	+ 7	+12
+ 6	+ 7	− 2	+ 5	+ 7	− 4	− 7	+ 9	+ 5.5	− 3.5	+19
+ 5	−10	+ 4	+ 7	+10	+ 1	−12	+ 9	+13.5	−13	+16.5
+ 4	+ 4	− 2	+ 5	0	+ 3	− 1	+ 4	+ 1	+10	+ 8
+ 1	− 1	+ 3	+ 9	+17	+ 5	0	+ 3	+ 9	+ 5.5	+ 3.5
+ 3.5	+11	+ 6	+ 3	+ 5	+ 8	− 4	+12	+ 8	+10	+ 6
+ 2.5	+ 8	+10	+10	+ 1	+10	− 4	− 3.5	+ 6.5	+ 2.5	+ 6.5

The mean of all these observations is +4′.5, which may be taken as equal to twice the zero error. The difference between this and the preceding observations will show the *errors* of the observations, which when classified are as follows:

+15′.5	+8′.5	+5′.5	+3′.5	+2′.5	+1′.5	−0′.5	−1′.5	−3′.5	−5′.5	− 8.5
14.5	7.5	5.5	3.5	2.5	1	.5	1.5	3.5	5.5	8.5
14.5	7.5	5.5	3.5	2.5	1	.5	1.5	3.5	6.5	8.5
12.5	7	5.5	3.5	2.5	.5	.5	1.5	3.5	6.5	11.5
12	6.5	4.5	3.5	2	.5	.5	1.5	3.5	6.5	14.5
10.5	6.5	4.5	3.5	2	.5	1.0	2.	4.5	7.5	16.5
9.5	5.5	4.5	2.5	1.5	.5	1.0	2.	4.5	8	17.5
9	5.5	4.5	2.5	1.5	.5	1.5	2.5	5.5	8	46.5

By far the greatest error here is −46′.5, which was obtained from the first observation. The difference between the readings with the face of the instrument and needle both east, and that with the former west and the latter east, instead of being −42′, should be +4′.5. This does not inform us which reading is most in error; if, however, we apply the correction to 72° 5′, making it read 72° 51′.5, the resulting dip would be 71° 54′.1, corresponding nearly with the other observations at the same place.

The average of all the preceding errors is $\pm 5'.5$, which may be taken as the probable error of a single reading entirely independent of instrumental errors, and the error frequently amounts to about a quarter of a degree. What then are we to understand by this result? Simply this, that if the instrument be properly adjusted, and a number of different readings be made *in the same position of the instrument and needle,* the needle each time being raised from its supports and allowed to come to a state of rest, the readings will not be identical. They will frequently differ $\pm 15'$ from the mean, and on an average $\pm 5'.5$. This is the conclusion derivable from Prof. Locke's observations, and the result I presume coincides substantially with the experience of all who have undertaken similar observations. My attention has been particularly directed to this very annoying and almost disheartening anomaly, and it has appeared to me that when the agate supports and the axis of the needle are carefully wiped clean of moisture and dust, the discordance of the readings arises mainly from the needle's slipping upon the agates to the east or west; and that when the *y*'s which elevate the needle are so disposed as to allow the least possible motion in that direction, the accordance of the readings is the best.

This uncertainty in the readings is of itself sufficient to entitle the dipping needle to the character of 'one very ungrateful instrument.' Most of the other errors may be corrected by suitable precautions and reversals; but this cannot be thus annihilated, and the only remedy with which I am acquainted is to multiply observations. I am accustomed to make five observations in each position of the needle and instrument, always reading at both poles. I thus obtain eighty readings with each needle.

Another error, and one which equally affects both needles, arises from observations being made *out of* the meridian. At Hudson, the dip increases less than one minute from being observed two degrees out of the magnetic meridian. Where one has leisure therefore to determine the magnetic meridian with accuracy, this error may be pronounced insensible; but on a tour where observations are usually hurried, the error from this source may become important.

Another source of error is found in the imperfection of the axles of the needles. It has long been known that different instruments would give different values of the dip at the same time and place. This fact is strikingly exhibited in the observations by Captain Ross, contained in the fifth report of the British Association. The dip at London, as given by eight different needles, was as follows:

69° 1′.5	69° 18′.9
6′.3	19′.6
11′.3	21′.8
16′.1	42′.6

Here we have a difference of 41′ in the results of two of the needles. This discordance was satisfactorily traced to the imperfection of the axles, and its effect may be in a measure corrected by making the axle turn in the needle, thus enabling the points of the circumference of the axle in contact with the supporting planes to be varied in successive trials; or it may be corrected by observations in different azimuths. The dip may be deduced from the angles of inclination observed in any two azimuths 90° apart from each other, by the formula $\cot.^2\delta = \cot.^2 i + \cot.^2 i'$; or it may be derived from the formula $\cot.\delta = \cot. i \sec. \theta$. Without some such trial or comparison with a standard instrument, no needle can be certainly relied upon. I have made this trial with my instrument, observing in every 10° of azimuth in the usual manner. Thus one thousand three hundred and sixty readings were made with each needle. I have made in all about four thousand readings to determine the magnetic dip at Hudson, and after all should not dare to use any stronger language than Prof. Locke employs respecting his own results derived from sixteen readings, that they "are accurate within at least two or three minutes of a degree."

Other errors arise from the presence of magnetism, as for example, in the instrument itself, iron about the person of the observer, which may sometimes inadvertently happen with the most cautious, loose iron lying unperceived in the vicinity, etc.; and finally, local attraction sometimes causes the dip at a given place to differ from that due to the geographical position by several degrees. This will be especially noticeable in the vicinity of iron mines, basaltic rocks, etc.

From the preceding remarks, I think it will be seen, that in magnetic observations we are not to look for the precision of astronomy. We have not sufficient data for estimating the *probable* error of one of Prof. Locke's results; yet I should not hesitate to admit a *possible* error of more than 10′ independent of local attraction, and this cause might easily increase the error to a half degree. I do not see how Prof. Locke can refuse his assent to this, after publishing the dip at Cincinnati to be in Nov. 1837, 70° 45′.7, and in April, 1840, writes, "I have lately found the dip at Cincinnati to vary between 70° 25′ and 70° 29′," and yet in his last article he assigns 0′.86 as the *limit* of instrumental error. As for the errors of my own observations, given on page 87, I have twice observed the dip at Cleveland, on two opposite sides of the city, and in both instances have obtained a result greater than was to have been expected from its geographical position. The other three observations were in Michigan, where I was told iron ore was quite abundant.

Art. IX.—*Description of some new species of Fossil Shells, from the Eocene, at Claiborne, Alabama;* by Henry C. Lea. Philadelphia, Oct. 17, 1840.

It has long been a desideratum to the American geologist, to have the fossils of the widely extended beds of the tertiary formation of this country, accurately described, and compared with those of a similar date in Europe. The works of my father, Mr. Conrad, and other geologists, have done much to effect this, but there are, still, no doubt, many undescribed species remaining. The following descriptions of species, which the author presumes to be new, are as exact as he was able to make them, as he frequently labored under the disadvantage of having but one specimen of a shell, and that one often fractured. They were mostly obtained from a box of sand from the tertiary deposit at Claiborne, which my father has identified with the London clay, or calcaire grossiere of European geologists. The author hopes that his descriptions are sufficiently clear and minute to determine the species permanently.

FAMILY MELANIANA.

Genus Pasithea.—*Lea.*

P. *minima*. Pl. 1, fig. 1.

P. testâ subulatâ, imperforatâ, politâ, tenuissimâ; apice obtusâ; suturis minimis; anfractibus ——, planulatis; columellâ lævi; aperturâ ovatâ.

Shell subulate, imperforate, polished, very thin; apex obtuse; sutures very small; whorls ——, flat; columella smooth; mouth ovate.

Length ——. Breadth ·04 of an inch.

Remarks.—This pretty little species is the smallest of the *Pasitheæ* that I have seen. Its mouth is acutely angular above, rounded below, and is about ·05 of an inch in length. The columella is somewhat thickened at base, and the outer lip is sharp. Its whiteness and polish, in which I believe it exceeds all the other fossils from Claiborne, give it an elegant appearance.

P. *cancellata.* Pl. 1, fig. 2.

P. testâ turritâ, subtenui, politâ, imperforatâ, cancellatâ; apice acutâ; anfractibus ——, convexis; suturis profundis; columellâ lævi; aperturâ sub-ellipticâ.

Shell turrited, somewhat thin, polished, imperforate, cancellate; apex acute; whorls ——, convex; sutures deep; columella smooth; mouth sub-elliptical.

Length ·3. Breadth ·15 of an inch.

Remarks.—It is probable that this beautiful little species attains a greater size, as I have a fragment of a specimen, the breadth of which is ·2 of an inch; it may therefore be regarded as the largest species of this genus from Claiborne. The mouth is rounded below and angular above, and about ·1 of an inch in length. The transverse striæ are larger than the longitudinal ones, and make the whole surface of the shell beautifully cancellate.

P. *elegans.* Pl. 1, fig. 3.

P. testâ subulatâ, transversè sulcatâ, imperforatâ, subcrassâ, politâ; apice acutâ; anfractibus nonis, planulatis; suturis minimis; ultimo anfractu ad basim striato; columellâ lævi; aperturâ sub-ellipticâ, sub-effusâ.

Shell subulate, transversely sulcate, imperforate, somewhat thick, polished; apex acute; whorls nine, flat; sutures very small; last whorl striated to the base; columella smooth; mouth sub-elliptical, somewhat effuse.

Length ·3. Breadth ·1 of an inch.

Remarks.—This pretty little shell has five striæ on each whorl, except the last, on which there are fifteen, those near the base being much smaller than the others; but as I have only one specimen, I cannot tell whether this is a constant character or not. It resembles the P. *sulcata*, Lea, in its furrows, but differs from it in other respects.

FAMILY PLICACEA.

Genus Actæon.—*Montfort.*

A. *lævis.* Pl. 1, fig. 4.

A. testâ subulatâ, politâ, lævi, tenui ; spirâ valdè elevatâ ; anfractibus ——, planulatis ; suturis impressis ; columella uniplicatâ ; aperturâ quadrilaterali.

Shell subulate, smooth, polished, thin ; spire very elevated ; whorls ——, flat ; sutures impressed ; columella with one fold ; mouth quadrilateral.

Length ——. Breadth ·05 of an inch.

Remarks.—This interesting little species somewhat resembles A. *elevatus*, Lea, but differs from it in having but one fold on the columella, in the shape of the mouth, and in size. The fold on the columella is unusually large for so small a shell. It is the most subulate Actæon that I have seen.

A. *magnoplicatus.* Pl. 1, fig. 5.

A. testâ turritâ, subcrassâ, lævi, politâ ; anfractibus ——, planulatis ; suturis impressis ; columellâ uniplicatâ, plicâ magnâ, acutâ ; labro acuto ; aperturâ ovatâ, sub-effusâ.

Shell turrited, somewhat thick, smooth, polished ; whorls ——, flat ; sutures impressed ; columella with one large sharp fold ; outer lip sharp ; mouth ovate, somewhat effuse.

Length ——. Breadth ·07 of an inch.

Remarks.—This little shell is remarkable for its large elevated fold, which is placed in the middle of the columella. The last whorl is angular below. The mouth is .05 of an inch in length. I have but a single whorl of a specimen of this species, but that presents characters so different from those of any species that I have seen, that I have no hesitation in pronouncing it to have been hitherto undescribed. This makes the eleventh Actæon described from the tertiary at Claiborne. The *striatus* described by my father, has been changed by him to *alveatus*, the former name having been pre-occupied by Mr. Sowerby.

FAMILY SCALARIANA.

Genus Scalaria.—*Lamarck.*

S. *elegans.* Pl. 1, fig. 6.

S. testâ turritâ, imperforatâ, tenui, politâ; spirâ acutâ; anfractibus senis, convexis, sessilibus; costis longitudinalibus quindecim; suturis profundis; columellâ lævi; aperturâ ellipticâ.

Shell turrited, imperforate, thin, polished; spire acute; whorls six, convex, sessile; with fifteen longitudinal ribs; sutures deep; columella smooth; mouth elliptical.

Length ·1. Breadth $\frac{1}{20}$th of an inch.

Remarks.—This is one of the most minute, and at the same time most elegant of the *Scalariæ* which I have seen. The last whorl is ribbed only to the middle. It differs from S. *planulata*, Lea, in having fifteen instead of twelve ribs on each whorl, in the mouth being elliptical, its size, &c.

S. *venusta.* Pl. 1, fig. 7.

S. testâ subulatâ, imperforatâ, crassâ; anfractibus ——, sessilibus, convexis, costis tredecim; ultimo anfractu carinato, costato ad carinam; suturis profundis; aperturâ sub-ellipticâ, parvâ.

Shell subulate, imperforate, thick; whorls ——, sessile, convex, with thirteen ribs; last whorl carinate, ribbed to the carina; sutures deep; mouth sub-elliptical, small.

Length ——. Breadth ·25 of an inch.

Remarks.—In this species the ribs are quite thick, and there is a large varix on each whorl. In this character it resembles the S. *quinquefasciata*, Lea, but it differs from it in other respects. I have been able to obtain but two specimens of this shell, both of which have the spire very much fractured; enough however remains to convince me of its differing from any species that I have seen.

FAMILY TURBINACEA.

Genus Turbo.—*Linnæus.*

T. *parvus.* Pl. 1, fig. 8.

T. testâ conicâ, ventricosâ, umbilicatâ, crassissimâ, lævi, politâ; umbilico parvo; anfractibus quaternis, planulatis; suturis impressis; aperturâ rotundâ.

Shell conical, ventricose, umbilicate, very thick, smooth, polished; umbilicus small; sutures impressed; whorls four, flat; mouth round.

Length ·07. Breadth ·05 of an inch.

Remarks.—This little species has no remarkable characters, but I cannot identify it with any described species. It somewhat resembles T. *naticoides*, Lea, but its greater elevation and small mouth, besides its not being so large, readily distinguish it from that species. I regret that from my single specimen having the mouth broken, I cannot determine whether it has the outer lip reflexed.

Genus Trochus.—*Linnæus.*

T. *planulatus.* Pl. 1, fig. 9.

T. testâ lenticulatâ, sub-crassâ, lævi, politâ; anfractibus quaternis, convexis; ultimo anfractu acutè carinato; suturis parvis; umbilico magno; aperturâ ellipticâ.

Shell lenticular, somewhat thick, smooth, polished; whorls four, convex; last whorl acutely carinated; sutures small; umbilicus small; mouth elliptical.

Length ·05. Breadth ·1 of an inch.

Remarks.—It is with considerable doubt that I have placed this shell in the genus Trochus, to which it seems, however, to belong, from the absence of crenulations on the umbilicus, which is not as large as in most *Solariæ* to which this shell would, at first sight, be referred. Its mouth, however, is perfectly elliptical, which seems to indicate a connection with the Turbo, to which, indeed, it bears a considerable affinity. It is remarkable as being the first Trochus observed in the deposit at Claiborne.

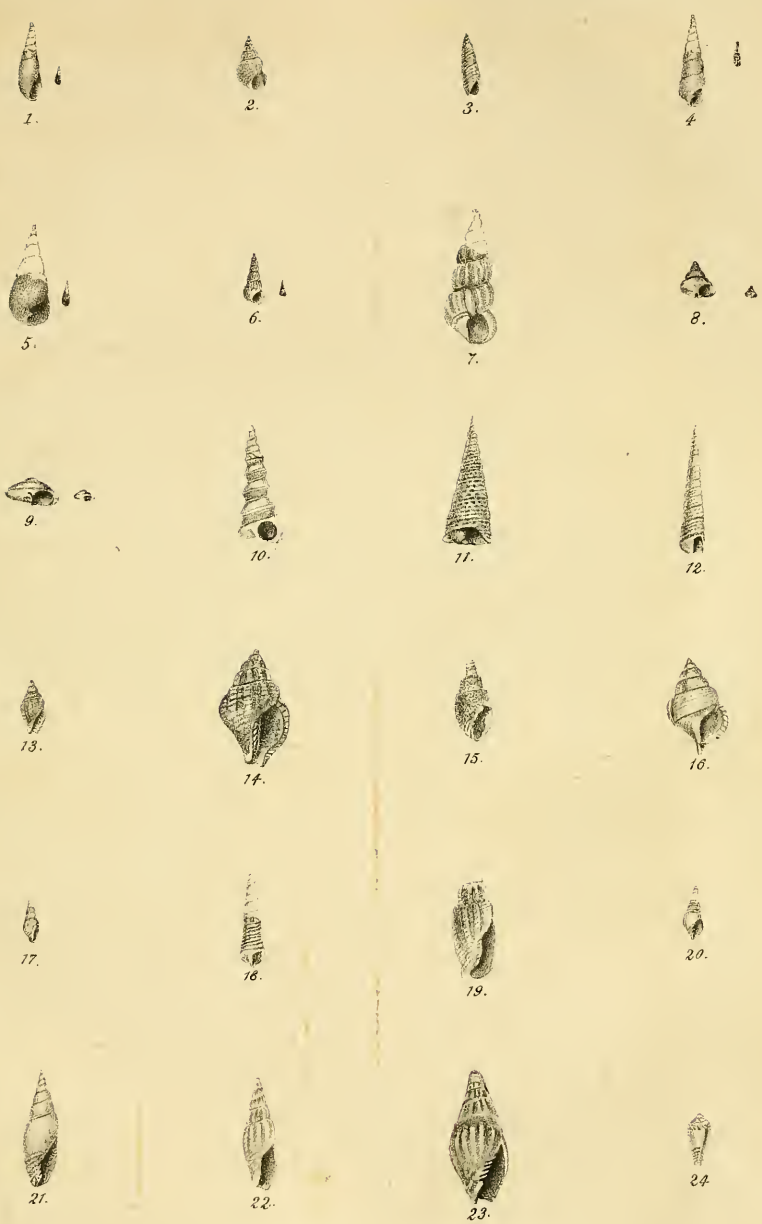
Genus Turritella.—*Lamarck.*

T. *carinata.* Pl. 1, fig. 10.

T. testâ turritâ, crassâ, transversè striatâ et carinatâ; anfractibus ——, valdè convexis, carinatis medio; suturis parvis; aperturâ rotundâ, sub-effusâ.

Shell turrited, thick, transversely striate and carinated; whorls ——, very convex, carinated in the middle; sutures small; mouth round, somewhat effuse.

Length ——. Breadth ·2 of an inch.



1. Pasithea minima.
2. " cancellata.
3. " elegans.
4. Actæon lævis.
5. " magnoplicatus.
6. Scalaria elegans.
7. " venusta.
8. Turbo parvus.
9. Trochus planulatus.
10. Turritella carinata.
11. " monilifera.
12. " gracilis.
13. Pleurotoma cancellata.
14. Turbinella fusoides.
15. Cancellaria pulcherrima.
16. Triton pyramidatum.
17. Buccinum parvum.
18. Terebra constricta.
19. " multiplicata.
20. Mitra gracilis
21. " eburnea.
22. " elegans.
23. Voluta dubia.
24. Conus parvus.

H. C. Lea. del.

P. S. Duval. Lith. Phil.

Remarks.—There are three striæ and a carina on each whorl, but as I have but a single specimen, I cannot determine whether this is a constant character. The striæ are very small, and are arranged, one near each suture and one on the under side of the carina, near its vertex. The whorls, from the magnitude of the carina, resemble a double cone, truncated at both ends. My specimen is fractured at the apex, so that the length and number of whorls cannot be satisfactorily determined.

T. *monilifera.* Pl. 1, fig. 11.

T. testâ turritâ, tenui, transversè striatâ, striis muricatis vel moniliferis; spirâ acutâ; anfractibus ——, sub-planulatis; suturis impressis; aperturâ sub-quadrilaterali.

Shell turrited, thin, transversely striate, with muricate or moniliferous striæ; spire acute; whorls ——, somewhat flat; sutures impressed; mouth sub-quadrilateral.

Length ——. Breadth ·25 of an inch.

Remarks.—This shell has four striæ, three large and one small one, which is near the upper suture. The sutures are very small from the flatness of the whorls. It bears a slight resemblance to some specimens of T. *lineata*, Lea, but may easily be distinguished from that species by the striæ being moniliferous, and the less convexity of the whorls, &c.

T. *gracilis.* Pl. 1, fig. 12.

T. testâ turritâ, tenui, transversè striatâ, striis latis; spirâ attenuatâ, acutâ; anfractibus ——, sub-concavis; suturis impressis; aperturâ sub-quadrilaterali.

Shell turrited, thin, transversely striate, with broad striæ; spire attenuated, acute; whorls ——, somewhat concave; sutures impressed; mouth sub-quadrilateral.

Length ——. Breadth ·1 of an inch.

Remarks.—In this shell there are two broad striæ, or rather elevations, which make the whorls convex. They are placed, one in the middle and the other in the upper part of the whorl. The sutures are distinct. This species seems to be very fragile, for although I have seen a number of specimens, none of them are perfect, most of them having the apex, and all the base, fractured.

FAMILY CANALIFERA.

Genus Pleurotoma.—*Lamarck.*

P. *cancellata.* Pl. 1, fig. 13.

P. testâ sub-fusiformi, sub-crassâ, cancellatâ, imperforatâ, striis longitudinalibus obliquis; spirâ acutâ; sinu magno, prope suturum; anfractibus septenis, convexis; suturis impressis; columellâ lævi, politâ; labro serrato, intus striato; aperturâ longâ; canale brevi.

Shell sub-fusiform, somewhat thick, cancellate, longitudinal striæ oblique, imperforate; spire acute; sinus large, near to the suture; whorls seven, convex; sutures impressed; columella smooth, polished; outer lip serrate, within striate; mouth long; canal short.

Length ·3. Breadth ·15 of an inch.

Remarks.—This pretty little shell is one of the most fusiform Pleurotomæ that I have seen. The mouth is half as long as the shell. The transverse striæ are much more elevated than the longitudinal ones, which on the last whorl become almost obsolete. The channel is shorter than in most Pleurotomæ, but is still very evident. The first and second whorls are smooth, the third has only longitudinal striæ, and the rest are cancellate.

Genus Turbinella.—*Lamarck.*

T. *fusoides.* Pl. 1, fig. 14.

T. testâ fusiformi, crassâ, imperforatâ, transversè ac longitudinaliter striatâ, longitudinaliter costatâ, costis maximis; spirâ acutâ; anfractibus septenis, convexis; suturis parvis, irregularibus; columellâ politâ, quadriplicatâ; labro intus striato; aperturâ sub-ellipticâ, canaliculatâ.

Shell fusiform, thick, imperforate, transversely and longitudinally striate, longitudinally costate, with very large costæ; whorls seven, convex; spire acute; sutures small, irregular; columella polished, with four folds; outer lip striate within; mouth sub-elliptic, channelled.

Length ·55. Breadth ·35 of an inch.

Remarks.—In this shell there are eight striæ on the inside of the outer lip, but as I have but one specimen, I cannot determine whether this is a constant character. They appear to be made in rows opposite every rib. The mouth is a little over half as long as the shell, being ·30 in length. The general form of this shell is more that of a Fusus, than of a Turbinella.

Genus Cancellaria.—*Lamarck.*

C. *pulcherrima.* Pl. 1, fig. 15.

C. testâ sub-fusiformi, cancellatâ, striis longitudinalibus æqualibus transversis, lineis crebrissimis parvis, transversis, sub-crassâ, umbilicatâ; spirâ obtusâ, mammillatâ; anfractibus senis, convexis, supernè angulatis; suturis impressis; umbilico parvo; columellâ duabis plicis; aperturâ sub-ellipticâ; canale brevissimo; labro crassissimo.

Shell sub-fusiform, cancellate, with the longitudinal striæ equal to the transverse ones, with small transverse lines very near each other, somewhat thick, umbilicate; spire obtuse, mammillate; whorls six, convex, angular above; sutures impressed; umbilicus small; columella with two folds; mouth sub-elliptical; canal very short; outer lip very thick.

Length ·4. Breadth —— of an inch.

Remarks.—This elegant little species is remarkable for the raised points at the intersections of the longitudinal and transverse striæ, which render it muricated, and give it a beautiful appearance. It resembles considerably C. *multiplicata*, Lea, but may easily be distinguished from that species, by its being cancellate and muricate, but I cannot determine whether the shape of the mouth differs, as the outer lip of my only specimen is very much fractured. The mouth is just half as long as the shell.

Genus Triton.—*Lamarck.*

T. *pyramidatum.* Pl. 1, fig. 16.

T. testâ turritâ, crassâ, politâ, transversè striatâ; spirâ acutâ; anfractibus nonis, convexis; suturis impressis; columellâ lævi; aperturâ sub-ellipticâ, sub-effusâ.

Shell turrited, thick, polished, transversely striate; spire acute; whorls nine, convex; sutures impressed; columella smooth; mouth sub-elliptical, somewhat effuse.

Length ——. Breadth ·3 of an inch.

Remarks.—It is with some hesitation that I have placed this shell in the genus Triton, to which, however, it appears to belong, from its irregular varicès, of which some of the whorls have but one, and some two. It appears to have had a rostrum at the base of the mouth, but as I have only a single specimen, which has it broken, I cannot determine its size. It is remarkable as being the first *Triton* observed in the Claiborne deposit. The mouth is ·2 of an inch in length.

FAMILY PURPURIFERA.

Genus Buccinum.—*Linnæus.*

B. *parvum.* Pl. 1, fig. 17.

B. testâ sub-turritâ, lævi, politâ, sub-crassâ; spirâ acutâ; anfractibus ——, planulatis; suturis impressis; basi striatâ; labro intus striato; aperturâ sub-quadrilaterali, canaliculatâ.

Shell sub-turrited, smooth, polished, somewhat thick; spire acute; whorls ——, flat; sutures impressed; base striated; outer lip striate within; mouth sub-quadrilateral, channelled.

Length ——. Breadth ·07 of an inch.

Remarks.—In this shell the outer lip has five striæ, but, as I have only one specimen, I cannot determine whether this is a constant character. The columella appears plicate, from the continuation of the striæ of the base. There is nothing very remarkable about this little species, although it is sufficiently marked to characterize it as new.

Genus Terebra.—*Lamarck.*

T. *constricta.* Pl. 1, fig. 18.

T. testâ subulatâ, attenuatâ, crassâ, transversè striatâ, striis tribus, longitudinaliter lineatâ; spirâ acutâ, valdè elevatâ; anfractibus ——, planulatis; suturis impressis; columellâ lævi; aperturâ sub-quadrilaterali; canale parvo, reflexo.

Shell subulate, attenuate, thick, transversely striate, with three striæ, longitudinally lined; spire very elevated, acute; whorls ——, flat; sutures impressed; columella smooth; mouth sub-quadrilateral; channel small, reflexed.

Length ——. Breadth ·1 of an inch.

Remarks.—But two specimens of this shell, and both with the spire very much fractured, have come under my observation, yet their shape is such as to leave no doubt in my mind that the spire is acute and very attenuate, in which it resembles most Terebræ. It approaches T. *venusta*, Lea, but differs from it in its transverse striæ, its want of longitudinal ribs, and in the channel being more reflexed.

T. *multiplicata.* Pl. 1, fig. 19.

T. testâ sub-turritâ, elongatâ, crassâ, transversè striatâ, longitudinaliter costatâ, costis maximis; anfractibus ——, valde convexis; suturis impressis; basi striatâ; columellâ quatuordecim plicis minimis; aperturâ ovatâ; canaliculo sub-recurvo.

Shell sub-turrited, elongated, thick, transversely striate, longitudinally costate, with very large costæ; whorls ——, very convex; sutures impressed; base striate; columella with fourteen very small folds; mouth ovate; channel small, somewhat recurved.

Length ——. Breadth ·25 of an inch.

Remarks.—This species much resembles the T. *gracilis*, Lea, but may be easily distinguished from that shell by the folds on the columella, its larger size, and its more strongly defined ribs. The mouth is ·25 of an inch long. Its apex seems to be very fragile, for, although I have several specimens, that figured is the most perfect.

FAMILY COLUMELLARIA.

Genus Mitra.—*Lamarck.*

M. *gracilis.* Pl. 1, fig. 20.

M. testâ sub-turritâ, tenui, longitudinaliter et indistinctè striatâ, lineâ transversâ propè suturas; spirâ acutâ, valde elevatâ; suturis impressis; anfractibus ——, planulatis; basi striatâ; columellâ triplicatâ; aperturâ sub-ellipticâ.

Shell sub-turrited, thin, longitudinally and indistinctly striate, with a transverse line near the sutures; spire acute, very much elevated; sutures impressed; whorls ——, flat; base striated; columella with three folds; mouth sub-elliptical.

Length ——. Breadth ·1 of an inch.

Remarks.—This little species has the outer lip sharp and without striæ. It resembles M. *lineata*, Lea, in having the longitudinal striæ and transverse line, but differs from that species in other respects. As I have met with but one specimen of this shell, and that with the spire fractured, I am not able to give its length and number of whorls. From the appearance of what I have, I should judge the spire to be very elevated.

M. *eburnea*. Pl. 1, fig. 21.

M. testâ sub-turritâ, lævi, sub-crassâ, politâ; spirâ sub-elevatâ, acutâ; suturis impressis; anfractibus octonis, sub-planulatis; basi striatâ; columellâ triplicatâ; aperturâ sub-ovatâ.

Shell sub-turrited, somewhat thick, smooth, polished; spire acute, elevated; sutures impressed; whorls ——, nearly flat; base striated; columella with three folds; mouth sub-ovate.

Length ·6. Breadth ·25 of an inch.

Remarks.—In this species the mouth is nearly one third as long as the shell. It much resembles the M. *minima*, Lea, but is easily distinguished from that species by its superior size, the three folds on the columella, and the number of striæ at the base, for this species has about twenty very fine ones, while the *minima* has only four or five large ones. Of the three folds on the columella the lowest one is very small.

M. *elegans*. Pl. 1, fig. 22.

M. testâ sub-turritâ, elongatâ, sub-crassâ, transversè striatâ, longitudinaliter costatâ; spirâ acutâ; anfractibus septenis, convexis; suturis impressis; columellâ octoplicatâ, plicis minimis; aperturâ sub-ovatâ, angustâ.

Shell sub-turrited, elongated, somewhat thick, transversely striate, longitudinally costate; spire acute; whorls seven, convex; sutures impressed; columella with eight very small folds; mouth sub-ovate, narrow.

Length ·5. Breadth ·2 of an inch.

Remarks.—This elegant Mitra has more folds on the columella than any other species I have met with. The M. *fenestrata* and M. *crenulata*, with a few others mentioned in Lamarck, having been separated under the name of *Conœlix*, to which genus, however, this shell cannot be referred, on account of the length of the spire. The longitudinal costæ become almost obsolete on the last whorl. The mouth is nearly half as long as the shell, being ·2 in length. The last whorl is striated to the base. This shell may be regarded as the link between the genera Mitra and Terebra, as it much resembles the T. *gracilis*, Lea, and T. *multiplicata* above described; however, its channel is not either marked or recurved enough for a *Terebra*.

Genus Voluta.—*Linnæus.*

V. *dubia.* Pl. 1, fig. 23.

V. testâ fusiformi, crassâ, longitudinaliter sulcatâ, striis transversis minimis; spirâ valdè elevatâ, mammillatâ; anfractibus septenis, planulatis; suturis minimis; columellâ quadriplicatâ; plicis inferioribus æqualibus superioribus; aperturâ angustâ.

Shell fusiform, thick, with very small transverse lines, longitudinally sulcate; spire very elevated, mammillate; whorls seven, flat; sutures very small; columella with four folds, the lower ones equal to the upper ones; mouth narrow.

Length ·7. Breadth ·35 of an inch.

Remarks.—The sulcations become more strongly marked upon the last whorl. It is with some doubt, that I place this singular shell among the *Volutæ*, to which genus, however, it seems to belong, from its mammillated apex; its general form, however, is that of a Mitra, while the folds on the columella are between the two, being all equal.* The mouth is only half as long as the shell, instead of extending nearly from the apex to the base, as in most Volutæ. Mr. Conrad has described two species of Mitra from Claiborne, the M. *pactilis* and M. *bolaris*, which, as they have mammillated spires, seem to me rather to belong to the Volutæ.

FAMILY CONVOLUTA.

Genus Conus.—*Linnæus.*

C. *parvus.* Pl. 1, fig. 24.

C. testâ conicâ, lævi, politâ, crassâ; anfractibus ——, planulatis, supernè et transversè striatis, longitudinaliter et obliquè plicatis infra angulatum; suturis parvis; basi striatâ; aperturâ angustissima.

Shell conical, smooth, polished, thick; whorls ——, flat, transversely striate above, longitudinally and obliquely folded below the angle; sutures small; base striated; mouth very narrow.

Length ——. Breadth ·12 of an inch.

Remarks.—This little shell has nothing remarkable about it, except its folds near the shoulder, which, together with its small size, distinguish it from the C. *sauridens* of Conrad.

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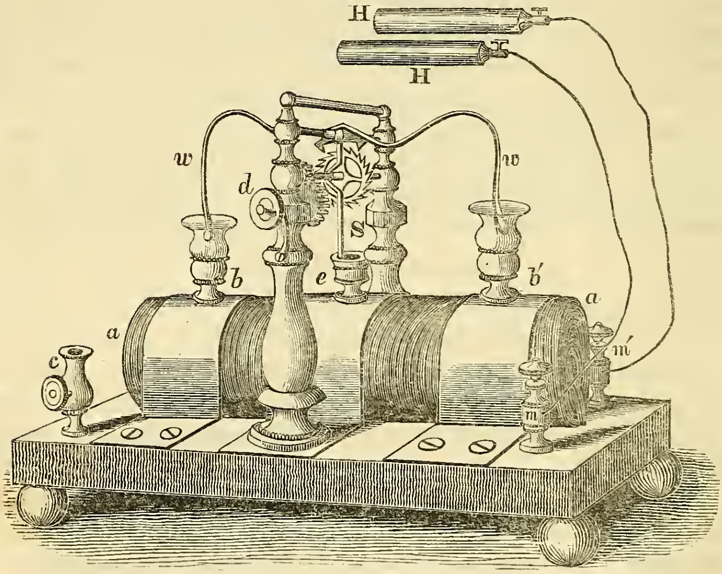
* The distinction between *Mitra* and *Voluta* is thus drawn by Lamarck, Animaux sans Vert. Vol. VII, part 1, p. 328. "C'est avec les Mitres que les Volutes ont le plus de rapports; mais elles en sont éminemment distinguées : 1, par les plis de leur columelle dont les inferieurs sont les plus gros et les plus obliques; 2, par l'extrémité de leur spire qui est obtuse ou en mammélon."

Art. X.—*A Description of several New Electro-Magnetic and Magneto-Electric Instruments and Experiments ;* by Joseph Hale Abbot, Mem. Am. Acad. Arts and Sciences, &c.

The following articles of apparatus, some of which have been invented more than a year, have not hitherto been described in any scientific journal. They seem to me to possess important advantages over all instruments of a similar kind now in use; and, so far as is known to me, some of the results obtained with with them are new. They are all manufactured by Mr. Daniel Davis, Jr., a very ingenious maker of magnetical instruments of this city.

Fig. 1.



Double Helix and Electrotome.—This instrument is represented by figure 1. The double helix, *a*, *a*, is nine inches long and two and a half inches in diameter. It forms a hollow cylinder, capable of containing a round rod about three fourths of an inch in diameter, and is confined to a base-board by three brass bands. The inner helix is composed of five strands of large, insulated copper wire, the aggregate length of which is about one hundred feet. The similar ends of these strands at one extremity of the helix, pass down through the base-board, underneath which they are soldered to the cup *c*. The similar ends at the other extremity of the helix, likewise pass down through the base-board, underneath which they are connected with the middle brass band *e*, which is surmounted with a brass cup containing mercury. Into this cup descends a copper wire *s*, connected above with the wire *w*, *w*, which by means of clock-work set in motion by a concealed spring, wound up at the milled head *d*, is made to vibrate rapidly, and to dip alternately into glass cups for containing mercury. The glass cups are open at bottom, so as to allow the mercury to be in contact with the brass supports, into which they are cemented, and which are fastened to the outer brass bands *b* and *b′*. These brass bands are connected underneath the base-board with a cup *c′*, not seen in the figure and corresponding to *c*. Both the cups *c* and *c′*, are furnished with binding screws to confine the wires by which the inner helix is connected with the battery.

Exterior to the helix just described, enclosing it and insulated from it, is another composed of about two thousand feet of small insulated wire, the two extremities of which are soldered to the cups *m* and *m′*, likewise furnished with binding screws. H and H′ are handles for shocks, connected with the cups *m* and *m′*. If we now suppose the copper pole of a voltaic battery to be connected with the cup *c*, and the zinc pole with the corresponding cup *c′*, the battery current will circulate unbroken through the several strands of wire composing the inner helix, to one of the outer bands; thence by the vibrating wire to the middle band, and thence to the cup *c′*, whenever either end of the vibrating wire dips into the mercury of the glass cups. As the vibrating wire approaches to a horizontal position, previously to the other end's dipping into the mercury of the other glass cup, the battery current is broken, and a bright spark is seen in the cup, in which the rupture of the current has just taken place. If the handles be grasped with moistened hands, severe shocks will be felt. Introduce into the helix a brass tube, and the spark becomes quite small, and the shock feeble. Next introduce a bundle of soft iron wires into the brass tube, and the spark and shock are not sensibly increased. If the tube be now withdrawn from the helix without withdrawing the iron wires, the spark will become exceedingly brilliant, and the shocks so severe that they cannot be endured a moment even by the firmest nerves. The intensity of the shock may be varied at pleasure by varying the number of the iron wires in the helix, the addition of a single wire producing a very manifest effect. If the brass tube be longitudinally divided on one side, it no longer diminishes the shock or spark.

The neutralizing influence of the outer helix, when its extremities are connected by means of a copper wire, admits of very satisfactory explanation on the principles discovered by Prof. Henry, and fully explained by him in his highly valuable paper published in the No. of this Journal for April last. On breaking the battery circuit, a secondary current being induced in each helix, and flowing in the same direction with the voltaic current, the secondary current in the outer helix tends to produce a tertiary current in the inner one flowing against the secondary, and, as shown by the diminution of the spark and shock, counteracting in a great measure its effect. Secondary currents, as was shown by Prof. Henry in a similar case, are likewise induced in the undivided brass tube, and produce a similar counteracting effect. The closed circuits must also act as a feeble prolongation of the battery current, and thus prevent that sudden neutralization of the magnetism of the enclosed iron bar or wires, which is essential to the bright spark and strong shock.

The superiority of a bundle of wires over a bar of iron, was discovered nearly at the same time by Dr. Page in this country, and by Mr. Bachhoffner in England. Dr. Page ascribes it to the mutual neutralizing action of similar poles, and the consequent greater suddenness of the change, which, at the moment the battery current is broken, takes place in the iron wires. To this cause must be added the absence of the closed circuits which are induced in the iron bar. I have not been able to perceive much advantage in insulating the iron wires contained in the helix, as was done by Mr. Bachhoffner. The effect of an iron bar in increasing the shock and spark, is very much enhanced by sawing it longitudinally on one side to the axis, by which the closed circuits, otherwise induced in it, are in a great degree prevented. An iron tube one eighth of an inch in thickness, produces a greater effect than a solid iron bar of the same diameter, though less than when the helix is equally filled with iron wires. The effect of an iron bar or of a bundle of iron wires, is not diminished by inserting them in a tube of glass or other non-conducting substance, before introducing them into the helix.

When a bar of iron is contained in the helix, and a small key or some nails are applied to one end of it, notwithstanding its magnetic attraction is intermitted every time the voltaic circuit is broken, yet, it being almost instantaneously renewed, they do not cease to be sustained. This experiment succeeds best when the iron bar is enclosed in a brass tube previously to being introduced into the helix, the closed circuits of the tube tending to prolong its magnetism.

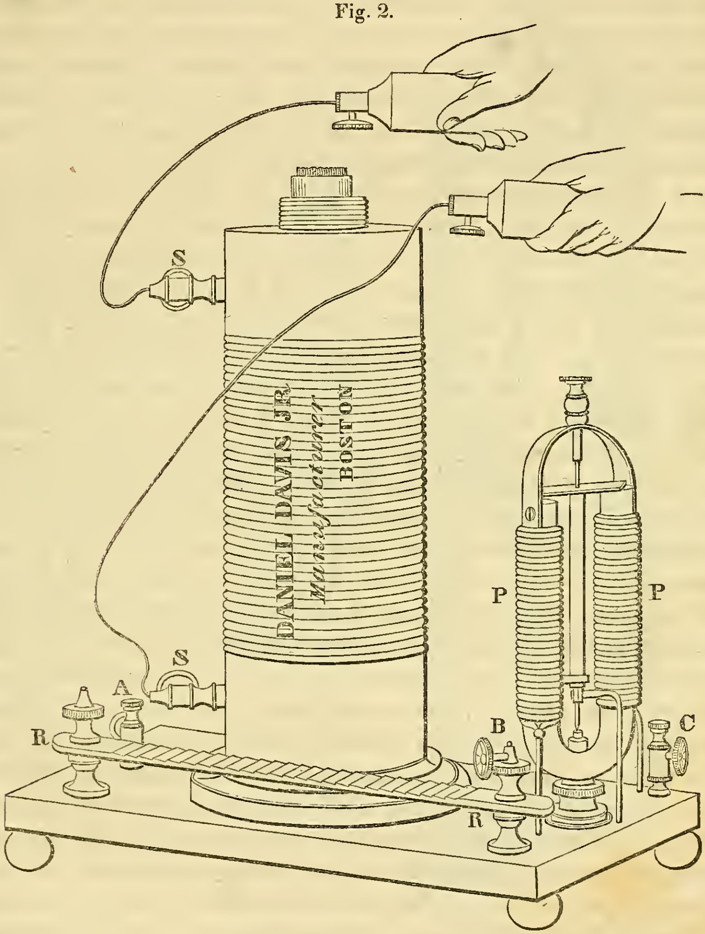
The double helix and electrotome, in consequence of being provided with a mechanical contrivance for breaking the battery circuit, may be used with a very small battery, although its effects are of course most striking, when used with a powerful one. If a voltaic pair, consisting of a silver dollar and a piece of rolled zinc of the same size be used, and the helix be filled with soft iron wires, the shock is quite severe.

Water may be decomposed by connecting the outer helix with an instrument for that purpose having very small platinum wires guarded with glass, as originally used by Wollaston. The extremities of the platinum wires, while the decomposition is going on, appear in a dark room, one constantly and brightly, and the other intermittingly and feebly luminous. If the apparatus for decomposition is removed out of the noise of the double helix and electrotome, rapid discharges are heard in the water, producing sharp ticking sounds, audible at the distance of eighty or a hundred feet, and synchronous with the ruptures of the voltaic circuit. Decomposition is effected both by the initial and terminal secondary currents, that is to say, by the currents induced both on completing and on breaking the battery circuit; but the ticking noise and sparks accompanying the rapid discharges in the water, are produced only by the terminal secondary current. Hydrogen may be kindled and brilliant scintillations produced by the double helix and electrotome. A Leyden jar, the knob of which is connected with the inside coating by a continuous wire, may be feebly charged, and slight shocks be rapidly received from it, by bringing the knob in contact with one of the cups of the outer helix, and grasping with the two hands respectively the outer coating of the jar and a handle connected with the other cup. The instrument is likewise very convenient for showing the spark of a magneto-electric machine, that is furnished with the contrivance, called by Dr. Page a *unitrep*, for causing the current induced by the magnet to flow in a constant direction. By making the proper connections, the magneto-electric current may be made to circulate through the inner helix in the same way as the voltaic current, producing sparks in the glass cups, and, if the handles connected with the outer helix be grasped, slight shocks. In addition to the experiments I have enumerated, the double helix and electrotome may be used for most of the purposes of a common simple helix.

Separable Helices and Revolving Armature.—This instrument, represented by figure 2, is similar in many respects to the preceding, and will require but little description. The two helices are composed of wires of about the same length and size, as those of the double helix and electrotome, but entirely disconnected with each other, so that the outer may be removed from the inner one. The latter is firmly secured in a vertical position to a base-board, underneath which one set of similar ends of its wires is soldered to the cup A, and the other set to the cup B. R R is a steel rasp, confined in close contact with the cup B. P P is a modification of Page's revolving armature, described in Vol. xxxv, p. 262, of this Journal. The extremities of the wire wound round the two branches of the electro-magnet, are respectively connected underneath the base-board with the cups B and C. The voltaic current may be transmitted in sequence through this instrument and the inner helix, by connecting the cups, A and C, with a battery. It is here used to break the battery current, which it does twice during each revolution of the armature. The battery current may be broken, without including the revolving armature in the voltaic circuit, by connecting one of the battery wires with the cup A, and drawing the end of the other over the steel rasp, in which case brilliant scintillations will be produced. S and S are cups fastened to brass caps, longitudinally divided, which enclose the ends of the outer helix, and to which the ends of the wire composing it are soldered. In the figure there is seen, projecting from the upper end of the inner helix, a brass tube filled with iron wires, which may be withdrawn. This instrument is peculiarly suited to the lecture-room on account of its simplicity, and the facility with which the powers and uses of its several parts may be separately exhibited.

Very many of the experiments before described, may be performed with it. Both this instrument and the double helix and electrotome, readily furnishing a rapid succession of shocks of every degree of intensity, are highly convenient for the medical application of electricity.

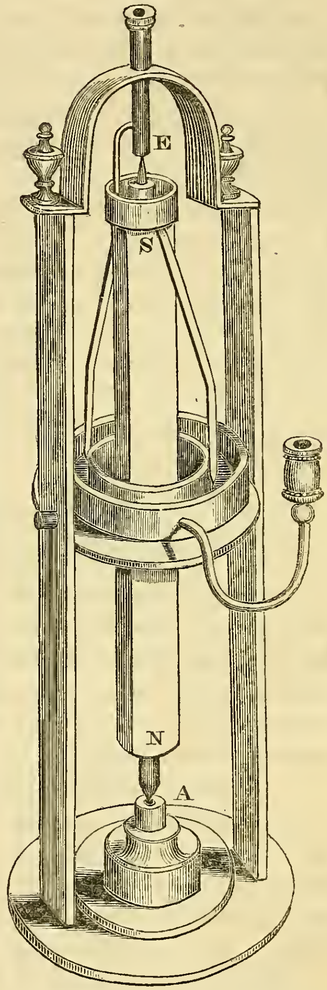
Fig. 2.



In September last, J. Smyth Rogers, M. D., of New York, then on a visit to this city, observed a difference in the intensity of the shocks received by the two arms when connected with the cups, S and S, of the separable helices and revolving armature. On his mentioning the circumstance to me, we undertook to verify the fact by more extended experiments. For this purpose we administered a succession of shocks of moderate intensity to six or eight individuals, several of whom were entirely unacquainted with the theory of the instrument. All of them perceived the same difference, as well when their backs were turned towards the instrument, as when it could be seen by them. Whenever the direction of the battery current was changed, or the outer helix was reversed, thus changing the direction of the induced currents, a corresponding change took place as to the arm most affected by the shocks; as was manifested not only by the sensations of the individual himself, but by a difference in the violence of the contractions produced in the two arms, visible to others. There is a similar difference in the intensity of the shocks received from the double helix and electrotome, and also, though less striking, in those received from a magneto-electric machine, in which the primary current is made to flow in a constant direction. On repeating the experiment with Prof. Henry, during a recent visit made by him to this city, he perceived the same difference of intensity of which I have spoken. I have ascertained by means of a galvanometer, that it is the arm connected with the negative cup, which is most convulsed, and experiences the strongest sensations. In determining the positive or negative character of the cups, regard was had only to the terminal secondary current, it being found that the initial secondary current, whether induced by means of a voltaic battery or a permanent steel magnet, produces comparatively feeble physiological effects, and consequently need not, in this case, be taken into account. Since the preceding facts were observed, I have met with an account in the Quarterly Journal of Science for the year 1830, of similar results obtained by Prof. Marianini, of Venice, with a voltaic battery of a considerable number of pairs of plates. He regards the difference in the intensity of the shocks as a purely physiological phenomenon, the greatest effect, both as it respects sensation and muscular contractions, being produced by the electric current, when it proceeds in the direction of the ramification of the nerves.

Instrument for exhibiting the simultaneous rotation of a magnet and conducting wire.—It was discovered by Faraday, that in the well known experiment of a conducting wire revolving round a magnet, the circumstance of the wire and magnet being joined together, does not affect the result. To show this fact, he used a magnet loaded at its lower extremity with platinum, and floating in a vertical position in a vessel full of mercury. The instrument represented by figure 3, illustrates the same fact without the inconvenience of using a large quantity of mercury, and, in consequence of the diminished resistance to be overcome, exhibits a much more rapid rotation than can be obtained by means of Faraday's apparatus. A magnet, pointed at both ends, is supported on an agate cup A, while its upper end is kept in place by slightly entering a small cavity in the lower extremity E of a small brass rod passing up through the arched top of the sustaining brass frame-work, and surmounted with a cup for making connection with a voltaic battery. From one side of the same rod, a copper wire passes down into a small cistern for containing mercury, resting on the shoulder of the magnet near its upper end. Two copper wires projecting into this cistern, descend into another of ivory, supported on a stage, and surrounding the middle of the magnet, but not touching it. One end of a large bent copper wire projects into the interior of the ivory cistern, and the other supports a cup for making communication with a battery. On putting a proper quantity of mercury into the cistern, and transmitting a voltaic current through the wires, the whole movable part of the apparatus will rotate with considerable velocity.

Fig. 3.



Boston, November 7, 1840.

ART. XI.—*Development of some interesting Properties of Numbers*; by GEORGE R. PERKINS.

IF we multiply a unit by any number N, and divide the result by a number P, then multiply the remainder by N, and again divide by P; and thus continue to multiply the remainder by N, and to divide by P: we shall obtain a succession of quotients and remainders which we will represent by $q_1, q_2, q_3, \ldots q_x$ and $r_1, r_2, r_3, \ldots r_x$.

From the above law of operation, we readily deduce the following equations:

$$\left.\begin{array}{l} N=Pq_1+r_1 \\ Nr_1=Pq_2+r_2 \\ Nr_2=Pq_3+r_3 \\ \vdots \\ Nr_{x-1}=Pq_x+r_x \end{array}\right\}(1)$$

From the first of these equations we can find r_1, which substituted in the second will make known r_2, which in turn substituted in the third will give r_3; and thus we may continue until we have obtained the following equations:

$$\left.\begin{array}{l} r_1=N-Pq_1 \\ r_2=N^2-P[Nq_1+q_2] \\ r_3=N^3-P[N^2q_1+Nq_2+q_3] \\ \vdots \\ r_x=N^x-P[N^{x-1}q_1+N^{x-2}q_2+\ldots+Nq_{x-1}+q_x] \end{array}\right\}(2)$$

Since r_x in the general equation of (2), is less than P, it follows that if we divide that equation by P, the remainder on the left hand side of the equation will be r_x; and consequently we must have the same remainder on the right. Now, since the term within the brackets is multiplied by P, it can leave no remainder when divided by P: hence we conclude,

That N^x *divided by* P *will give* r_x *for remainder.*

If in the general equation (2), we substitute M for the expression within the brackets, we shall obtain $r_x=N^x-PM$ (3), this being true for all values of x, we shall also have $r_{x'}=N^{x'}-PM'$ (4). Multiplying (3) and (4) together, we get $r_x \times r_{x'}=N^{x+x'}-P[MN^{x'}+M'N^x-PMM']$ (5). Hence we conclude,

That $r_x \times r_{x'}$ *divided by* P, *will give* $r_{x+x'}$ *for remainder.*

From the general equation of (1) we discover,

That $(N-R)q_x$ *divided by* N, *will give the same remainder as* r_x *divided by* N, *where* R *is the remainder of* P *divided by* N.

It is evident that the process will terminate whenever we obtain $r_x=0$; but when this is not the case, the quotients and remainders must recur in periods whose number of terms cannot exceed $P-1$; for there can be but $P-1$ different remainders; so that if we extend the process beyond $P-1$ terms, we shall be sure to fall upon a remainder like one that has already occurred, and then the quotients and remainders will begin to repeat.

Thus far our conclusions have been general, that is, they are correct for all values of N and P. We will now deduce some properties which hold for particular values of N and P.

When P is a prime, and N is not divisible by P, we know by the *celebrated theorem of Fermat*, that N^{P-1} divided by P will leave 1 for remainder, that is $r_{P-1}=1$. Hence we conclude, that $r_x=r_{x+P-1}$ (7), also $q_x=q_{x+P-1}$ (8).

It also follows, *that when the number of terms in the periods of quotients and remainders is less than* $P-1$, *it must be a submultiple of* $P-1$.

Suppose we should find $r_{\frac{P-1}{n}}=P-1$, then the remainder $r_{\frac{P-1}{n}+1}$ will be found by dividing $NP-N$ by P, or simply by dividing $-N$ by P; we have already indicated the remainder of N divided by P, by r_1; therefore the remainder of $-N$ by P will be $-r_1$, or more correctly $P-r_1$. Hence $r_{\frac{P-1}{n}+1}=P-r_1$ or $r_{\frac{P-1}{n}+1}+r_1=P$; after the same manner we prove $r_{\frac{P-1}{n}+x}+r_x=P$ (9).

From the general equation of (1) we get $Pq_x=Nr_{x-1}-r_x$, (10). Changing x into $\frac{P-1}{n}+x$ we have $Pq_{\frac{P-1}{n}+x}=Nr_{\frac{P-1}{n}+x-1}-r_{\frac{P-1}{n}+x}$, (11). Taking the sum of (10) and (11) and reducing by means of (9), we get $q_{\frac{P-1}{n}+x}+q_x=N-1$, (12). Therefore, *whenever the remainder* $r_{\frac{P-1}{n}}=P-1$, *the number of terms in the periods of quotients and remainders will be* $\frac{2(P-1)}{n}$ *and* *these quotients and remainders will satisfy the conditions of equations* (9) *and* (12).

We know by the *Theory of Numbers*, that the remainder of $N^{\frac{P-1}{2}}$ divided by P is either 1 or $P-1$. *Hence, it follows that when the remainder is* $P-1$, *the number of terms in the periods will be* $P-1$ *or a submultiple of* $P-1$. *And when the remainder is* 1, *the number of terms in the periods must be* $\frac{P-1}{2}$ *or else a submultiple of* $\frac{P-1}{2}$.

If N is a composite number of the form x^a, β^b, γ^c, &c. when x, β, γ, &c. are prime factors, and a, b, c, &c. are whole numbers, and P is also a composite number, whose prime factors do not differ from those which compose N, then the process will terminate; for x can be so taken as to make N^x divisible by P without a remainder.

If P, besides containing the prime factors common to N, contains other prime factors, the process will not terminate, but must give periods of quotients and remainders; but in this case, other terms will occur before the periods commence.

If N and P are both primes, the one of the form $4n+1$, and the other of the form $4n+3$, we know by the law of *reciprocity of primes*, that if the remainder $r_{\frac{P-1}{2}}$ is $P-1$, then also will the remainder $r_{\frac{P-1}{2}}$ be $P-1$, when N and P exchange places; so that the number of terms in the periods in the first case, will be $P-1$; and in the second case, $N-1$.

We will now illustrate these singular properties by numerical results. If $N=20$ and $P=37$, we shall have as follows:

Quotients	0,	10,	16,	4,	6.	9,	14,	11,	17,	16,	15,	2,	14,	1,	1,	12,	8,	12
	19,	9,	3,	15,	13,	10,	5,	8,	2,	3,	4,	17,	5,	18,	18,	7,	11,	7
Remainders	20,	30,	8,	12,	18,	27,	22,	33,	31,	28,	5,	26,	2,	3,	23,	16,	24,	36
	17,	7,	29,	25,	19,	10,	15,	4,	6,	9,	32,	11,	35,	34,	14,	21,	13,	1

We have arranged the quotients in two horizontal lines, so that the q_x is directly over the $q_{\frac{P-1}{2}+x}$ quotient; in this arrangement, we more readily see that they satisfy the condition (12); the remainders we have arranged in a similar manner.

If N=16, and P=13, the quotients will be 1, 3, 11; the remainders will be 3, 9, 1.

If N=70=2 . 5 . 7, and P=32=2^5, the quotients will be 2, 3, 8, 52, 16; the remainders will be 6, 4, 24, 16, 0. In this case the process terminates.

If N=13, and P=11, the quotients will be $\left\{\begin{matrix} 1, & 2, & 4, & 9, & 5 \\ 11, & 10, & 8, & 3, & 7 \end{matrix}\right.$

The remainders will be $\left\{\begin{matrix} 2, & 4, & 8, & 5, & 10 \\ 9, & 7, & 3, & 6, & 1 \end{matrix}\right.$

Now exchanging the values of N and P, that is, taking N=11, and P=13, we get the quotients $\left\{\begin{matrix} 0, & 9, & 3, & 4, & 2, & 5 \\ 10, & 1, & 7, & 6, & 8, & 5 \end{matrix}\right.$, the remainders $\left\{\begin{matrix} 11, & 4, & 5, & 3, & 7, & 12 \\ 2, & 9, & 8, & 10, & 6, & 1 \end{matrix}\right.$

If N=509, and P=19, we find $r_{\frac{P-1}{2}}=18=P-1$, therefore the number of terms in the periods will be P−1. And since N and P are both primes, the one of the form $4n+1$, and the other of the form $4n+3$, it follows that if N=19, and P=509, the number of terms in the periods will be P−1=508.

When N=10, our process resolves itself into the usual rule for converting the vulgar fraction $\frac{1}{P}$ into its equivalent decimal.

If P=7, N being supposed 10, we find the quotients to be $\left\{\begin{matrix} 1, & 4, & 2 \\ 8, & 5, & 7 \end{matrix}\right.$, the remainders are $\left\{\begin{matrix} 3, & 2, & 6 \\ 4, & 5, & 1 \end{matrix}\right.$. Hence $\frac{1}{7}=0.142857$ repeated in endless succession. Now it is obvious that the same succession of figures must represent in decimals the value of any vulgar fraction whose denominator is 7 and numerator less than 7; it is also evident that the period will commence with that quotient which follows the remainder which is equal to the numerator of the fraction; thus $\frac{2}{7}=0.285714$; $\frac{3}{7}=0.428571$; $\frac{4}{7}=0.571428$; $\frac{5}{7}=0.714285$; $\frac{6}{7}=0.857142$.

If P=17, the quotients will be $\left\{\begin{matrix} 0, & 5, & 8, & 8, & 2, & 3, & 5, & 2 \\ 9, & 4, & 1, & 1, & 7, & 6, & 4, & 7 \end{matrix}\right.$, and the remainders will be $\left\{\begin{matrix} 10, & 15, & 14, & 4, & 6, & 9, & 5, & 16 \\ 7, & 2, & 3, & 13, & 11, & 8, & 12, & 1 \end{matrix}\right.$. Therefore,

$\frac{1}{17}=0.0588235294117647$; $\frac{2}{17}=0.1176470588235294$;
$\frac{3}{17}=0.1764705882352941$; $\frac{4}{17}=0.2352941176470588$;

thus we could with the same period of figures represent in decimals, the fractions $\frac{5}{17}$, $\frac{6}{17}$, $\frac{7}{17}$, &c.

The following fractions, $\frac{1}{19}$, $\frac{1}{23}$, $\frac{1}{29}$, $\frac{1}{43}$, $\frac{1}{47}$, $\frac{1}{59}$, $\frac{1}{61}$, and $\frac{1}{97}$, when expressed in decimals, will give similar results.

If P=101 the quotients will be $\left\{\begin{matrix} 0, 0 \\ 9, 9 \end{matrix}\right.$, the remainders $\left\{\begin{matrix} 10, & 100 \\ 91, & 1 \end{matrix}\right.$

If P=103 we find $r_{\frac{P-1}{6}}=P-1$ ∴ the number of terms in the periods is $\frac{P-1}{3}=34$; which will satisfy equations (9) and (12).

If P=107 we find $r_{\frac{P-1}{2}}=1$ ∴ the number of terms is $\frac{P-1}{2}$ not subject to the conditions of (9) and (12.

If P=109 we find $r_{\frac{P-1}{2}}=P-1$ ∴ the number of terms is P−1 subject to the conditions of (9) and (12).

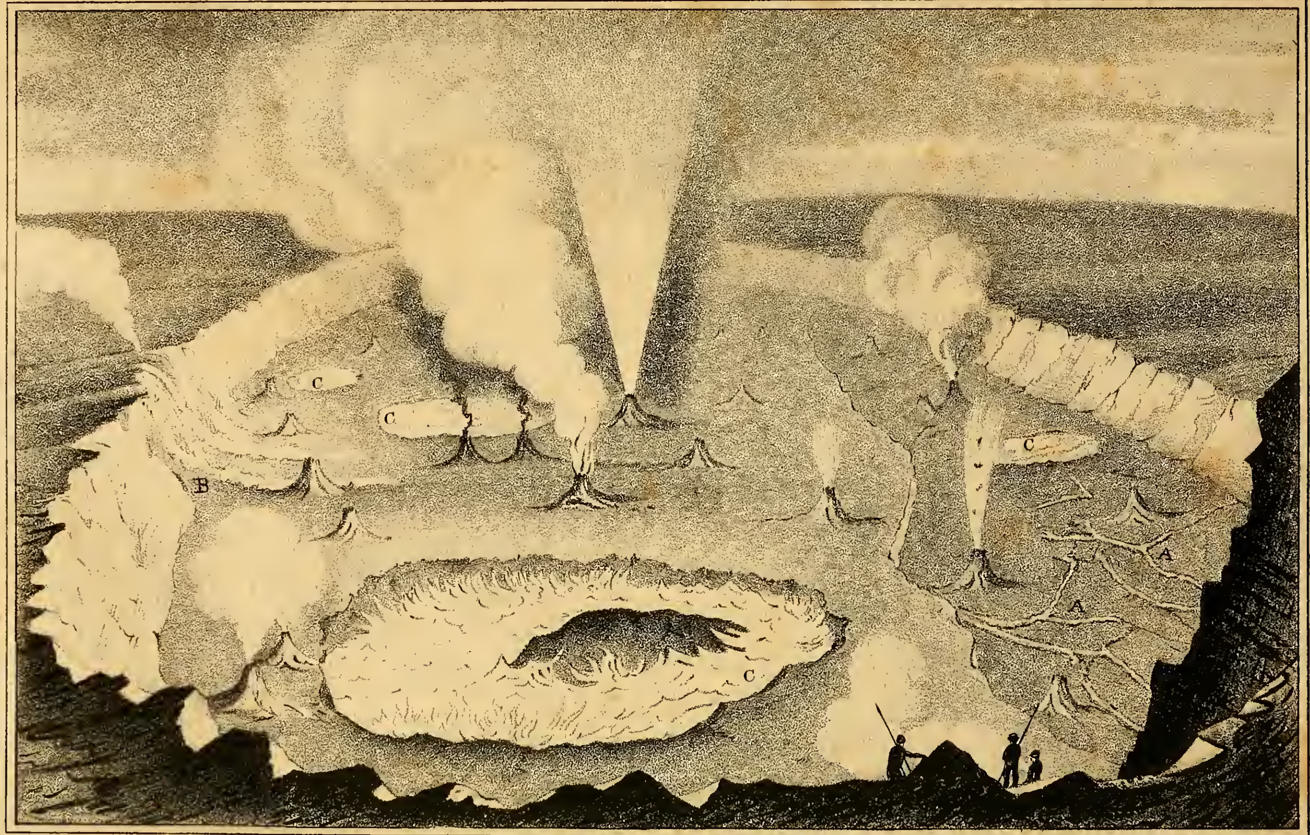
If P=137 we find $r_{\frac{P-1}{34}}=P-1$ ∴ the number of terms is $\frac{P-1}{17}=8$ which are subject to the conditions of (9) and (12).

If P=139 we find $r_{\frac{P-1}{6}}=P-1$ ∴ the number of terms is $\frac{P-1}{3}$ subject to the conditions of (9) and (12).

If P=719 we find $r_{\frac{P-1}{2}}=1$ ∴ the number of terms is $\frac{P-1}{2}$ not subject to the conditions of (9) and (12).

If P have the following values, 113, 131, 503, and 863, we shall find $r_{\frac{P-1}{2}}=P-1$, so that in each case the number of terms is P−1, subject to the conditions of (9) and (12).

If P=1019 we proceed in the ordinary way until we obtain the remainders $r_1=10$; $r_2=100$; $r_3=1000$; $r_4=829$; $r_5=138$; $r_6=361$. We then multiply r_6 into itself and divide the product by 1019, and find for remainder $r_{12}=908$; multiplying r_{12} into itself and dividing by 1019 we find $r_{24}=93$; after the same manner we find $r_{48}=497$; $r_{96}=411$; $r_{192}=786$; $r_{384}=282$; $r_{480}=755$; $r_{504}=923$; $r_{507}=805$; $r_{509}=r_{\frac{P-1}{2}}=$



R. Bakewell, Del.

Lith. of E. B. & E. C. Kellogg Hartford, Ct.

Crater of Kirauea, in the Island of Hawaii, as it appeared in 1838.

Drawn by R. Bakewell, from Sketches by Capt. Parker & Chase. Communicated by E. C. Kelley.

For description see Page 272

$1018 = P - 1$. Therefore, if we convert $\frac{1}{1019}$ into a decimal fraction, the number of decimal places before repeating will be 1018.

Operating, as in the last example, it would not be difficult to find the q_x quotient, as well as the r_x remainder, be x however great, for any prime value of P.

Utica, October 21, 1840.

Art. XII.—*Remarks on the Geological Features of the Island of Owyhee or Hawaii,* the largest of the group called the Sandwich Islands, with an account of the condition of the Volcano of Kirauea, situated in the Southern part of the Island near the foot of Mouna Roa. Drawn up from statements made by Captain Chase, of the ship Charles Carroll, and Captain Parker, of the ship Ocean, who visited it in* 1838; by Edward G. Kelley, of Nantucket. (See frontispiece.)

The Island of Owyhee, like many of the islands in the Pacific Ocean, is of volcanic origin. Vast streams of lava have flowed over its whole surface, and on every side of its lofty mountains, whose summits are covered with perpetual snow. Some of these streams have rolled on for thirty and forty miles over a great extent of country, and plunged from the precipitous cliffs which skirt the island into the billows of the ocean. A single current which flowed from one of the large craters on the top of Mouna Huararai, in the year 1800, filled up an extensive bay, twenty miles in length, and formed the present coast.

The recent formations of lava present a vitreous and dazzling surface, without a shrub or spot of grass, while those of ancient date have undergone decomposition, until a soil has been formed which is capable of bearing the most useful and beautiful vegetable productions. Where once the fiery torrent rolled, stretches the verdant forest, and the rude islander sows his seed and plants his roots in soil that once glowed like the burning coal.

The natural senery of the Island of Owhyhee, is sublime and interesting; having for ages, been subject to frequent and powerful volcanic eruptions, and rent by the most violent earthquakes. In many places currents of lava have flowed over abrupt pre-

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* For notices on this subject, see this Journal, Vols. xi, p. 1; xx, p. 228.

cipices, and formed beautiful stalactites, massive columns and striking resemblances to the mountain cascade, whilst in others the whole stream has been torn from its original position by some mighty convulsion, leaving huge blocks of lava standing erect or leaning against others for miles, which present a dreary and desolate appearance. In the early part of 1823, an entire mountain, which attained an elevation of six hundred feet, was thrown into the sea during the shock of an earthquake, and its fragments mixed with the ruins of houses and forest trees were scattered along the coast for half a mile, presenting a scene of frightful desolation.

One impressive feature of this island, is its majestic mountains, some of which rise fifteen or twenty thousand* feet above the level of the sea, and are higher than the Peak of Teneriffe, or the summit of Mount Blanc. For several thousand feet, they are beautifully decorated with extensive forests and verdant meadows, in which immense herds of cattle roam at large, with droves of swine and other animals, but at greater elevations they present a rugged and barren surface.

Having given in the few remarks above, some account of the geological character of the island, we will proceed to describe the great crater of Kirauea, as it appeared on the eighth of May, 1838.

Early in the morning, on the seventh of May, Captains Chase and Parker, in company with several others, left the port at Lord Byron's Bay, for the purpose of visiting the celebrated volcano Kirauea. After travelling a few miles through a delightful country interspersed with hill and valley, and adorned with clusters of trees, hung with the richest foliage, they came to a forest several miles in extent, so entangled with shrubs, and interwoven with creeping vines, that its passage was extremely difficult. On issuing from this, the scenery again wore a pleasing aspect, but was soon changed into a dreary waste. Their route was now in the direct course of a large stream of lava, thirty miles in length and four or five in breadth. The lava was of recent formation, with a surface, in some places, so slippery as to endanger falling, and in others, so rugged as to render it toilsome and dangerous to pass. Scattered around, were a few shrubs that had taken root in the volcanic sand and scoriæ, and on each side of the stream grew a stinted forest. Mouna Roa and Mouna Kea, were seen in the dis-

* Probably the first number may be nearest to the truth.—Eds.

tance, and on either side stretched the broad expanse of the ocean, mingling with the far horizon. The party had travelled nearly the whole extent of the current of lava before sunset; they were, however, much fatigued and gladly took possession of a rude hut erected by the islanders, where they slept soundly through the night.

Early the next morning, ere the sun rose, they resumed their journey, and soon a beautiful landscape broke upon their view, but its delightful scenery detained them only a few moments, for the smoke of the volcano was seen rising gracefully in the distance. Quickening their march, they arrived soon after nine o'clock at a smoking lake of sulphur and scoriæ, from which they collected some delicate specimens of crystallized sulphur, and proceeded on. The next object which attracted the attention, was a great fissure five or six hundred feet from the crater. It was about thirty feet wide, five or six hundred feet long, and from all parts of it constantly issued immense bodies of steam, so hot that the guides cooked potatoes over it in a few minutes. The steam, on meeting the cold air, is condensed, and not far from the fissure on the north, is a beautiful pond formed from it, that furnishes very good water and is the only place where it occurs for many miles. The pond is surrounded with luxuriant trees, and sporting on its surface were seen large flocks of wild fowls.

It was now 10 o'clock, and the whole party, since passing the lake of sulphur, had been walking over a rugged bed of lava, and standing by the side of vast chasms, of fathomless depth. They had now arrived at the great crater of Kirauea, eight miles in circumference, and stood upon the very brink of a precipice, from which they looked down more than a thousand feet into a horrid gulf, where the elements of nature seemed warring against each other. Huge masses of fire were seen rolling and tossing like the billowy ocean. From its volcanic cones, continually burst lava, glowing with the most intense heat. Hissing, rumbling, agonizing sounds came from the very depths of the dread abyss, and dense clouds of smoke and steam rolled from the crater.

Such awful, thrilling sights and sounds were almost enough to make the stoutest heart recoil with horror and shrink from the purpose of descending to the great seat of action. But men who had been constantly engaged in the most daring enterprise*—

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* Whale fishery.

whose whole lives had been spent on the stormy deep, were not easily deterred from the undertaking.

Each one of the party, with a staff to test the safety of the footing, now commenced a perilous journey down a deep and rugged precipice, sometimes almost perpendicular, and frequently intersected with frightful chasms. In about forty five minutes they stood upon the floor of the great volcano.

Twenty six separate volcanic cones were seen, rising from twenty to sixty feet; only eight of them, however, were in operation. Up several of those that were throwing out ashes, cinders, red hot lava, and steam, they ascended, and so near did they approach to the crater of one, that with their canes they dipped out the liquid fire. Into another they threw large masses of scoriæ, but they were instantly tossed high into the air.

A striking spectacle in the crater at this time, was its lakes of melted lava. There were six; but one, the southwest, occupied more space than all the others. Standing by the side of this, they looked down more than three hundred feet upon its surface, glowing with heat, and saw huge billows of fire dash themselves on its rocky shore—whilst columns of molten lava, sixty or seventy feet high, were hurled into the air, rendering it so hot that they were obliged immediately to retreat. After a few minutes the violent struggle ceased, and the whole surface of the lake was changing to a black mass of scoriæ; but the pause was only to renew its exertions, for while they were gazing at the change, suddenly the entire crust which had been formed commenced cracking, and the burning lava soon rolled across the lake, heaving the coating on its surface, like cakes of ice upon the ocean-surge. Not far from the center of the lake there was an island which the lava was never seen to overflow; but it rocked like a ship upon a stormy sea. The whole of these phenomena were witnessed by the party several times, but their repetition was always accompanied with the same effects.

They now crossed the black and rugged floor of the crater, which was frequently divided by huge fissures, and came to a ridge of lava, down which they descended about forty feet, and stood upon a very level plain, occupying one fourth of the great floor of the crater. This position however was found very uncomfortable to the feet, for the fire was seen in the numerous cracks that intersected the plain only one inch from the surface. Capt. Chase lighted his cigar in one of them, and with their walking-sticks they could in almost any place pierce the crust, and penetrate the liquid fire.

Sulphur abounds every where in and around the volcano; but here the whole side of the precipice, rising more than a thousand feet, was one entire mass of sulphur. They ascended several feet and were detaching some beautiful crystallized specimens, when accidentally a large body of it was thrown down and that rolled into a broad crack of fire and obliged them immediately to retreat, for the fumes that rose nearly suffocated them.

They had now been in the crater more than five hours, and would gladly have lingered, but the last rays of the setting sun were gilding the cliffs above, and they commenced their journey upward, which occupied them about one hour and a quarter.

They repaired to their rude hut, and while the shades of evening were gathering, dispatched their frugal meal. Curiosity, however, would not allow them to sleep without revisiting the great crater. Groping along, they reached the edge of the precipice and again looked down into the dread abyss, now lighted up by the glowing lava.

The whole surface of the plain, where they had observed cracks filled with fire, appeared as though huge cables of molten lava had been stretched across it. While examining these splendid exhibitions, the entire plain, more than one fourth of the whole crater, was suddenly changed into a great lake of fire; its crust and volcanic cones melted away and mingled with the rolling mass. They now hurried back, astonished at the sight, and shuddering at the recollection that only a few hours had elapsed since they were standing upon the very spot.

The next morning they returned to the crater for the last time. Every thing was in the same condition: the new lake still glowed with heat, the volcanic cones hurled high in the air red hot stones mixed with ashes and cinders, and accompanied with large volumes of steam, hissing and cracking as it escaped, and the great lake in the southwest was still in an agitated state.

The situation of the volcano Kirauea is very remarkable, differing from every other of which we have an account. It is not a truncated mountain, rising high above the surrounding country and visible from every quarter, nor is it seen until the traveller, after crossing an elevated plain near the foot of Mouna Roa, suddenly arrives at a precipice from which he looks down into its dread immensity.

The traditions of the natives furnish us with no account of its origin. Centuries on centuries have probably rolled away since, during which vast changes may have taken place. Some suppose it was once a lofty mountain* that has been consumed by the devouring element, constantly raging at its base, and emptied by some subterranean channel into the ocean.

Nantucket, November 29th, 1840.

P. S. I wish here to express my thanks to Thomas Macy, Esq., without whose interest in the subject, whatever is novel or valuable in the above account might have been lost.

I have read the preceding account to Capt. Chase, who says it is very good and correct, excepting that the language is in some places too mild, falling short of the reality, although it still seems to me that many who read the description, will think it exaggerated. E. G. K.

Description of the Frontispiece, presenting a view of the Volcano of Kirauea, as it appeared on the 8th of May, 1838.

The spectator is supposed to be stationed at the south end of the volcano looking north. A portion of the floor of the crater is hid by the projecting rocks in front of the picture. The area of the volcano is in the form of an ellipse; its longest diameter is from north to south, being about eight miles in circumference. The sides of the crater vary from eight hundred to one thousand feet in height.

A, A, represent fissures in the floor of the crater through which the fire approaches within one inch of the surface. This portion of the floor is considerably lower down in the crater than the general level. B, B, Streams of sulphur which have run down the sides of the crater, and appear in the form of cascades. C, C, C, Lakes of fire, the largest two and a half miles in length, half a mile in breadth, with an island of floating lava heaving up and down in the liquid mass.

Twenty six separate cones, from twenty to sixty feet in height, rose from the floor of the crater—eight were in action.

Six liquid lakes of fire of various dimensions.

The whole of that portion of the crater marked A A, in a few hours from the visit of the travellers, fell in and became one vast field of liquid fire.

* Collapsed or exploded.—Eds.

Art. XIII.—*The employment of Iodine as a reagent for Hydrosulphuric Acid;* by M. Alphonse du Pasquier.

TO THE EDITORS OF THE AMERICAN JOURNAL OF SCIENCE.

Gentlemen,—The original of this article was published in the March number of the Annales de Chimie et de Physique, and the importance of its being generally known to those who devote any of their time or attention to the investigation of our mineral waters, many of which are more or less impregnated with hydrosulphuric acid and the alkaline hydrosulphates, has induced me to transmit to you, for publication, a translation of such parts as explain the method of employing the reagent in question, and the conclusions that M. Alphonse has arrived at by his varied experiments.

The sulphohydrometer that is described, is of easy application, and enables one to obtain very accurate results in a short space of time, particularly when use is made of a table that I have calculated and annexed.

As regards the strength of the tincture of iodine, that is altogether optional with the individual who employs it; it being only requisite to have a knowledge of the amount of iodine contained in a measured portion of the liquid. I should propose, as most convenient, that each division on the sulphohydrometer should answer to $\frac{1}{10}$ of a grain of iodine, and a subdivision to $\frac{1}{100}$.

Yours respectfully, J. Lawrence Smith, M. D.

Paris, Sept. 20, 1840.

"To determine the proportion of hydrosulphuric acid, either free or in combination in sulphureous waters, is an operation attended with considerable difficulty, and of which the results are far from being certain. All the methods employed to arrive at this end, comprising even the process of M. Grotthuz, (the employment of ammoniacal nitrate of silver,) adopted by M. Anglada, and the generality of the chemists of the present day, present great difficulties of detail, and are, as has been demonstrated in my first memoir, subject to gross errors, particularly when we obtain a sulphuret more or less impure; and moreover when the quantity of hydrosulphuric acid is very minute they cease to act.

"In my researches upon the waters of Allevard, the uncertainty of these methods, made me desire to discover some process more satisfactory, when, employing as a reagent the alcoholic tincture of iodine, (it not being among those ordinarily used;) I found that the decomposition of the hydrosulphuric acid by this metalloid, was complete and instantaneous, and that one could determine, in a very easy manner, the precise point at which the decomposition of the hydrosulphuric acid is achieved, or when the iodine no longer enters into combination. I conclude, from this fact, that, with a tincture of which I know before hand the proportions, I shall be able to ascertain, by the quantity of iodine employed to saturate a litre of the sulphurous water, the precise amount of hydrosulphuric acid which it contains.

"Moreover, I am able to ascertain the quantity of iodine employed, without the use of a balance, by the means of an instrument which I call a sulphohydrometer. This instrument is a graduated tube, which allows the tincture of iodine to flow from an elongated extremity with a capillary opening, the other extremity being closed by a stopper.

"To employ the sulphohydrometer, we take a certain quantity of the sulphurous water which we may wish to analyze, and placing it in a porcelain capsule, add a few drops of a very clear solution of starch, and then allow the tincture of iodine to fall upon it, drop by drop, from the instrument, previously filled to the point marked 0°, and continue the addition so long as no change takes place in the color of the water, favoring the reaction by agitation with a glass rod. So long as there remains the smallest trace of hydrosulphuric acid, the iodine disappears as fast as it is introduced, and the starch, upon which iodine in a state of combination does not act, gives rise to no coloration of the liquid until the hydrosulphuric acid is completely saturated, when the minutest addition of iodine at once strikes a blue color with it. We then examine how many degrees of tincture have been employed, and knowing the strength of it, we are enabled to calculate the quantity of hydrosulphuric acid decomposed by it.

"This method of analysis, independent of its affording results of the most accurate character, has the additional advantage of being executed in so short a space of time, that one may make from fifteen to twenty experiments in less than one hour, and at the same time be perfectly sure of committing no error. It is also so easily put into practice, that any physician or intelligent person may apply it, and assure themselves daily of the variation in the strength of the sulphurous waters caused either by atmospheric changes or an admixture with rain water.

"The conclusions that I have arrived at by my experiments, are as follows:—

"1st. That the best known reagents for hydrosulphuric acid are subject to great objections, since they do not indicate even notable quantities of this acid, free or combined; a circumstance that explains why its presence has not been demonstrated in waters whose physical properties rank them as sulphureous.

"2d. That an alcoholic solution of iodine, employed along with starch, is a very sensible reagent for hydrosulphuric acid, free or in a state of combination. It can detect, in an undoubted manner, (by a comparative examination with common water,) a drop of concentrated solution of any of the alkaline hydrosulphates, disseminated in one hectolitre* of water, although the known reagents lose their action when the same quantity is disseminated in only ten litres.†

"3d. That with the tincture of iodine and starch we can recognize infallibly, in the weakest sulphureous waters, in those where ordinary reagents are useless, not only the presence, but also the quantity of hydrosulphuric acid, either free or in a state of combination.

"4th. That the known processes for determining the proportion of hydrosulphuric acid, free or combined, are so long and difficult that their result is uncertain and incorrect, especially in regard to waters possessing but little of the sulphureous principle."

Table of the quantity of Hydrosulphuric Acid decomposed by quantities of Iodine from $\frac{1}{100}$ to 10 grains.

IODINE.	HYDROSULPHURIC ACID.		IODINE.	HYDROSULPHURIC ACID.	
Weight in grains.	Weight in grains.	Bulk in cubic inches.	Weight in grains.	Weight in grains.	Bulk in cubic inches.
.01	.001351	.003691	.60	.08106	.22146
.02	.002702	.007382	.70	.09457	.25837
.03	.004053	.011073	.80	.10808	.29528
.04	.005404	.014764	.90	.12159	.33219
.05	.006755	.018455	1.00	.13510	.36910
.06	.008106	.022146	2.00	.27020	.73820
.07	.009457	.025837	3.00	.40530	1.10730
.08	.010808	.029528	4.00	.54040	1.47640
.09	.012159	.033219	5.00	.67550	1.84550
.10	.013510	.036910	6.00	.81060	2.21460
.20	.027020	.073820	7.00	.94570	2.58370
.30	.040530	.110730	8.00	1.08080	2.95280
.40	.054040	.147640	9.00	1.21590	3.32190
.50	.067550	.184550	10.00	1.35100	3.69100

* Hectolitre, about 26½ gallons. † Ten litres, about 2½ gallons.

Art. XIV.—*Notice of Geological Surveys.** I. *Of the State of Ohio.* II. *Of Indiana.* III. *Of Michigan;* by Oliver P. Hubbard, M. D., Prof. of Chemistry, Mineralogy and Geology, in Dartmouth College, N. H.

I. *Second Annual Report on the Geological Survey of the State of Ohio;* by W. W. Mather, *Principal Geologist, and the several Assistants.*—Columbus, 1838.

An abstract of the first report for 1837, was given in this Journal, Vol. xxxiv, p. 196. There existed a rumor, that the survey would not be continued. The Legislature, however, made another appropriation, and the results of the labors of the second year's survey are here presented. The work has never been resumed, and thus has ended for the present, we trust not finally, an undertaking, in its nature calculated to spread innumerable benefits throughout the whole state. Upon whom rests the responsibility it is not our province here to inquire. That much dissatisfaction has existed in certain quarters is, we believe, true. It is also no doubt a fact, that from the surveys heretofore made, very important advantages have been derived to the state, which are availed of in the manufacture of salt and iron, in the exploration of coal, &c.—in pointing out the limits of the different formations, thus directing the applications of enterprise to proper fields and preventing useless expenditure in places where investigation for valuable minerals would be fruitless. The development of the physical resources of a country—of ores and coal, materials for architecture and the arts, of saline and medicinal springs, excites a degree of healthy industry, whose returns enrich the inhabitants and at the same time improve their moral condition. Ohio, in its most thickly settled portions, is found to be richly stored with mineral wealth; and these districts being best known and most accessible, were the first examined by the geologists. The results of the former examination seem to have excited some jealousy in other quarters, "that no part of the state would be benefitted by the geological survey but the coal and iron region;" and "the geologists were directed to make surveys of some counties which were not expected to reap any benefit from the survey," and supplies of useful materials for the arts

* Dr. Jackson's Survey of Rhode Island is noticed in our bibliography.

and for building were found in abundance. Where these are in the vicinity of water carriage, they may become articles of commerce, otherwise their value is only local. The abandonment of the survey will prevent those important results to science which were reasonably anticipated—except what may be yet derived from materials in the possession of the geologists; and we hope these may yet be digested in some form to connect in regular continuity and system the rock formations of Ohio with those of all the neighboring states where surveys have been undertaken. In the present report is given the geological structure of eleven counties in different portions of the state, viz. Adams and Athens, on the south on the Ohio river, Butler in the southwest, Wood in the north, Portage and Trumbull in the northeast, and Crawford, Licking, Muskingum, Tuscarawas, and Hocking, more centrally.

Local and general sections of the strata, with particular lithological descriptions of the rocks, are given. There are a few figures of organic remains, and we are constantly met with the deficiency of characteristic specific catalogues of the fossils so indispensable to a minute comparison of these with other formations. This deficiency would, we trust, have been supplied had the survey been carried forward to its completion. Col. Whittlesey had collected materials towards the construction of a topographical as well as geological map. His observations upon the variations of the magnetic needle and the altitude of places were numerous, but must of course remain comparatively useless. His plans and descriptions of a great number of the ancient mounds we trust will be given to the public, for the intrinsic value they possess in relation to the early history of this country, which is now attracting more successful research than ever before.

Dr. Locke has appended to his report the records of the barometer and thermometer at a great number of places.

The zoological report of Dr. Kirtland is a very extended list of the Fauna of the state in the department of "mammalia, birds, reptiles, fishes, testacea, and crustacea." He gives the scientific term with the common name, the author of original description, with very instructive and interesting notes on many of the species. From some comparison of the mammalia and birds, the resemblance appears to be very great to the list given in the last New York report.

The economical results of the present geological report are so similar to those recited from the former one, and so full an account of eastern and central Ohio was given by Dr. Hildreth in Volume XXXIX, of this Journal, that a few extracts descriptive of the geology of Butler and some adjacent counties, which is below the carboniferous series, will suffice. The rocks in the southwestern portion of the state are thus described by Dr. Locke: "The rocks in the western states below the coal formation have evidently been deposited in the bed of a deep primitive ocean, and consist of alternations and *mixtures of crystalline and sedimentary* matters, mostly in thin layers, varying from *one* inch to *twenty four* inches. The *crystalline* strata are mostly carbonate of lime. The *sedimentary* strata are, in the lower portions, clay marl, and in the upper portions clay and sandstone. The *mixtures* are in the lower portions, lime and clay, forming either a durable slate limestone, or an indurated marl which falls to pieces on exposure to the air; in the superior portions, of lime, clay, and sand, forming an arenaceous limestone. All of these formations abound with the fossilized remains of marine animals."

The arrangement of the rocks is shown in the following table, beginning at the bottom.

"1. Blue limestone, (coming to the surface at Cincinnati and all places within fifty miles of it,) in thickness at least				1000 ft.
2. Clay marl, at West Union, Adams co. E. of Cincin.,				25
3. Flinty limestone,	"	"	"	51
4. Clay marl,	"	"	"	106
5. Cliff limestone,	"	"	"	89
6. Slate, (black bituminous,) at Rockville,				251
7. Waverley sandstone, east line of Adams county,				343
				1865 ft.

"The country from Cincinnati to West Union, which stands on an escarpment of the cliff limestone one hundred feet above the surrounding region, is of a nearly uniform level, the various elevated points, as ascertained by actual barometrical measurement, differing not more than thirty six feet from each other, and being usually five hundred feet above low water at Cincinnati."

Dip.—"The strata are nearly horizontal, and having a slight and irregular undulation, the dip is with difficulty ascertained," causing it to appear "uniform and consistent for half a mile" in one locality, and then in another it would be in an opposite direction. By examining "the several formations on a large scale, the dip becomes very evident; and as one formation sinks gradually below the surface and another superior one presents itself, it gives rise to those important changes in the face and productions of the country which we should hardly attribute to a slope so moderate as *one inch in a rod.*"

In connexion with Dr. Owen, geologist of Indiana, Dr. Locke found that near the boundary of the two states, there is a summit level and an anticlinal axis from which the strata dip in opposite directions—eastwardly in Ohio, and westwardly in Indiana—so that the "cliff limestone, which shows itself not many miles *east and west* of Richmond, Indiana, descends and comes to the bed of the Ohio river at the east side of Adams county, Ohio, and at the falls of the Ohio, at Louisville, Ky." "The outcropping edges of the strata, therefore, present themselves at the surface in the same order in the two states."

The "blue limestone region," is covered by the rock called the "*blue limestone,*" which is the lowest rock that has been penetrated in this region. With its alternate layers of marl and marlite, it is the exclusive rock even to the tops of the hills from West Union in Adams county, to Madison in Indiana, and from Dayton in Montgomery county, and Eaton, Preble county, Ohio, on the north, to a line forty or fifty miles up the Licking river, in Kentucky. At these places, or near them, the "*cliff limestone*" caps the hills; while the blue limestone is found in the beds of the streams, extending in some instances twenty miles farther, and passes under all of the other strata.

This extensive region is a table land five hundred feet above the low water mark of the Ohio. Its valleys and the channels of the streams are "sometimes bounded closely by abrupt banks, or widening to half a mile or even four miles, present a rich arable alluvion or bottom lands." Where the marl is abundant and becomes removed by the action of the weather, the layers of rock (broken into irregular fragments) are undermined and slide down with the earth, and are never left standing out in cliffs; hence the banks and hills are usually rounded.

"The soil has been formed mostly from rocks and marl, identical with those which now lie beneath it, except where it has been brought and deposited by waters, and does not contain at the surface so much lime as we should anticipate, and rarely, if ever, when undisturbed, does it effervesce with acids. On the tops of the hills around Cincinnati, the loam lies seven to nine feet deep before any stones are mingled with it, and *this loam is not effervescent with acids.* As soon as a layer of stone has been passed, all below it is highly so." By ordinary processes, the lime has been undoubtedly removed from the upper part of the soil; "hence the yellow loam near the surface is more useful for the manufacture of bricks that that which comes from between the layers of stone; the latter is uniformly effervescent, and contains from 12 to 25 per cent. of carbonate of lime."

The blue limestone, though classed as a transition rock by Dr. Locke, received no particular designation, while Mr. Conrad considers it as the Trenton limestone of New York, and the equivalent of the Caradoc sandstone of Murchison.* No specific enumeration of its organic remains is given, although they differ from those of the "cliff limestone" as below. There is a series of rocks, eight hundred feet in thickness, between this foundation rock and the coal formation of Ohio, and at its point of greatest altitude already referred to, it separates the coal basins of Ohio and Indiana into two distinct and well characterized formations.

The "*cliff limestone*," that lies on the "*blue*" limestone, is separated from it as in the section of Adams county, by extensive deposits of marl and intermediate limestone, which are much less in other places, and is not fissured like the latter, but is entire throughout its whole thickness of eighty feet, and where it is cut through by the rivers, presents mural bluffs or "cliffs," whence its name; or when it forms the bed of the streams it often causes cascades and occasions falls, as in the Ohio, at Louisville. It is less hard and compact than the lower limestone, often soft and friable like a loose sandstone, and even porous, spongy and arenaceous; of various colors, yellowish, reddish gray, and almost white, and is highly fetid and bituminous. In some places, it is without fossils, in others highly fossiliferous. The organic remains of both limestones are marine, and consist of corallines, univalves (?) bivalves, and trilobites—sometimes the species are identical in both, although generally different. The Corallines of the blue limestone are small and branched; those of the "cliff" are in large

* Vide this Journal, Vol. xxxviii, p. 87—88.

cylinders, four inches in diameter,—Madrepores in hemispheres three feet over, associated with Encrini an inch in diameter, and much larger than those in the blue. The blue contains Orthoceratites, and the fragments of large trilobites, one of which, called "Isotelus maximus," is figured as reconstructed from the proportions of the fragments, and is twenty one inches long. These strata are nearly horizontal, having a prevalent dip of north fourteen degrees east, and about six feet in a mile.

Large areas of this rock being uncovered for the purpose of quarrying, it is found planished as if by the friction of some heavy body moving over it, and marked by parallel grooves, which are regarded by Dr. Locke as "diluvial scratches;" they are found at "Light's quarry, east of the Miami, and seven miles above Dayton, thus rendered particularly interesting by the discovery in it of 'diluvial grooves,' a circumstance which I had thought probable from the fact of the planishing or grinding down of the strata" first observed at Col. Partridge's quarry, "where the upper surface, especially at the apex of its convexity, has its roughness nearly worn off, not by corrosion or by decomposition, nor by the attrition of sand and gravel, but by the grinding of a flat surface, making the work, so far as it went, a perfect plane, and leaving the pits of the deepest cavities entirely untouched."* "Light's quarry has been 'stripped' of soil, more or less, over ten acres, and the upper layer of stone is in most places completely ground down to a plane, as perfectly as it could have been by a stone-cutter by polishing." "In many places, grooves and scratches in straight and parallel lines, are distinctly visible, evidently formed by the progress of some heavy mass, propelled by a regular and uniform motion. The grooves are in width from lines scarcely visible, to those three fourths of an inch wide, and from one fortieth to one eighth of an inch deep, traversing the quarry from between north 19°, to north 33° west, to the opposite points in lines *exactly straight*, and in fascicles of sometimes ten in number, *exactly parallel;* clearly in compact limestone, without seam or fault of any kind—and in a surface ground down to a perfect plane." To illustrate these appearances, a por-

* These cavities are found, where another layer of the rock lies upon this, to answer to salient points in the upper one, and the "natural surface of the stone is within certain limits as rough as can be conceived, there being sharp teeth, an inch long, projecting from one layer and entering the contiguous one."

tion of the stone was taken, and by the process of "medal ruling," a perfect engraving was made by the tracer, and a picture is given in the report (p. 230) of great distinctness. The blue limestone abounds with the Strophomena of Raf., while the cliff has few of them. The shell of the fossils is often preserved in the blue, while in the cliff limestone only the cast is found.

6. The *argillaceous shale*, or "bituminous slate," occurs next. This is black and highly fissile ; in some parts very bituminous and fetid, and when accidentally ignited will burn for several days. It absorbs water freely, and then exfoliates. It contains spheroidal septaria of an impure blue limestone, from a few inches to three feet in diameter, that are filled with crystals of carbonate of lime, or sulphate of barytes.

It crops out on a line from the east side of Adams county, passing north through Columbus, and is two hundred to three hundred feet thick. Balls of iron pyrites are found in it, which decompose and form copperas and alum.

Mineral springs, charged with these and magnesian salts, abound in this and the bed of clay between it and the cliff limestone, and cause the numerous "licks," which are now resorted to by domestic animals as they were formerly by the herds of wild animals.

7. The "*fine grained Waverly sandstone*" succeeds the shale. It is white, yellowish, purple and blue, but more commonly drab ; more or less argillaceous in some parts, and contains oxide of iron, that causes ready decomposition—in others exceedingly compact and adapted to building, and for hearth-stones in furnaces. As the superior rock, it occupies, in the central part of the state, a band running about east north east, twenty miles wide, and with a dip east south east thirty feet in a mile, and a thickness of nearly four hundred or five hundred feet. The upper part abounds in Encrini, Ammonites, Productæ, Terebratulæ and Spiriferæ, and in the southern part of the state, Fucoides are found. A bed of clay appears to separate this from

8. A "*conglomerate*" or "millstone grit," that underlies the coal measures, and which is generally composed of quartz pebbles, and coarse-grained sand, or it assumes a fine texture and becomes a hard compact sandstone with but few pebbles, and crops out at short intervals in its line of junction with the sandstone in abrupt precipitous ledges of one hundred feet high. The nu-

merous salt wells of this state in some cases extend to this formation, and in others do not reach it.

9. The "*coal measures*" which succeed this are composed as usual of repeated series of limestone, sandstone, shale, iron ore and coal, and are particularly described in this Journal by Dr. Hildreth.

The organic remains are of the common coal plants—Lepidodendra, *two feet in diameter*, Calamites of great size, and Sigillaria with their bristling spines perfectly preserved and standing out in every direction, with numerous ferns. The inclination of the coal measures is east south east, thirty five to forty feet in a mile, and the direction north north east, with a thickness in Muskingum county of twelve hundred to fourteen hundred feet.

Between the blue and cliff limestone are the "*great marl stratum*," one hundred and six feet thick, and the "*flinty limestone*," well developed in Adams county. The former is blue and stratified—by the action of frost and weather it becomes lighter colored, and when dry is almost white.

"It is earthy, highly effervescent, contains few fossils, and is traversed by thin layers of reddish slaty limestone, two or three inches thick."

The "*flinty limestone*," like the "blue," lies in thin layers interstratified with marl, but differs from it in color, in fossils, and especially in having certain layers filled with silicious matter in chemical combination, (not arenaceous,) has the sharp, conchoidal, flinty fracture, and fires with steel; oftentimes very much broken up in small triangular pieces—in others an excellent building stone, and never appears *weathered.* Cyathophylla and Crinoidea, of various forms, and corallines, are observed in a few strata. Chert, (or flint?) in nodules, is found in Indiana and at Cincinnati, in the soil, and they become more numerous as we approach Adams county, where they are found in their native bed in this formation. This suggests the idea that it once extended much farther west.

II. *Report of a Geological Survey of Indiana*, 1839, *by* D. D. Owen, M. D.

The examination of this state, though general, has been extended to almost every one of the old counties, and its geology is so like that of Ohio, that details in its description may not be necessary. The portion of the state north of the National Road, is covered by a deep deposit of diluvium, and the channels of the streams only afforded opportunities for studying the rocks.

The east and north portions have the same geology as the neighboring part of Ohio. The "blue limestone" is the lowest and oldest rock in Indiana, and alternates with clays and marls, as in Ohio. It retains its highly fossiliferous character, and in this particular Dr. Owen thinks it greatly resembles "the mountain limestone" of Europe; of course, for want of the evidence, no one else can have an opinion, except to refer to that of Mr. Conrad. This forms a dividing ridge between the waters running into the Wabash and Ohio, in the southeast counties of Switzerland, Dearborn, Franklin, Union, and Fayette; it forms the eastern boundary of the cliff stratum, and it is found that below Union county, certainly, the cliff strata of the two states are not continuous. It occupies the elevated ridges in Jefferson, Ripley, Decatur, and Rush, and the eastern part of Scott, Jennings, and Shelby counties; and from Elkhorn, Wayne county, to Fall creek, in Fayette county, the "cliffs" of the two states are separated by an interval of eighteen or twenty miles, and they are the prevalent rock in the northeast, under the diluvium.

The "black or bituminous slate," which begins at Floyd county, one hundred and four feet thick, passes up through Clark, is seen at Delphi on the Wabash, and is the next rock in the ascending order. A series of sandstones, limestones, clays, shales, bituminous coal, and argillaceous iron ores—in fact, a regular bituminous coal formation, distinct from the Ohio and Michigan basins, succeeds these carboniferous deposits—and constitutes the latest rocks that have yet been observed in the state. Dr. Owen remarks:—"Our bituminous coal formation is part of a great coal-field, which includes nearly the whole of Iowa, Illinois, and eight or ten counties in the northwest part of Kentucky. It occupies in Indiana an area of about seven thousand seven hundred and eighty square miles—beginning on the Ohio, where the second principal meridian crosses it, it passes three miles east of the line, between Martin and Lawrence counties; crosses the National Road one or two miles west of Putnamville; crosses the Upper Wabash near Independence, thence northwest into Illinois to the mouth of the Kankakee." This coal resembles very much that of Meigs county, Ohio, exhibiting "spots and regular layers of absolute charcoal from which the woody fibre can be detached."

Dislocations of a few inches are occasionally seen. The rocks dip very gradually toward the west. "Large quantities of argillaceous iron ore and carbonate of iron are associated with the slaty clays of the formation at its eastern border, where are" excellent fire clays, potter's clay, furnace hearth-stones, and slates, from which copperas and alum can be manufactured on a large scale. Sandstones for building, for grind and whetstones, are very superior.

Boring for salt water through the white sandstones at the margin of the coal formation is encouraged, as they are regarded by Dr. Owen as the equivalent of the saliferous formation of the Muskingum and Kenawha. "A brine affording a pound of salt from a gallon of water was procured near the mouth of Coal Creek, in Fountain county," from a boring that passed through the coal beds themselves to the depth of seven hundred feet. Between the "soft, fine-grained, greyish or brownish grey sandstone of the knobs in Floyd county, and the coal formation" is a series of limestones, the "oolitic" or "encrinital," of Kentucky and of Tennessee, described by Dr. Troost in the iron region of Tennessee. "This limestone formation is the termination of the true carboniferous and saliferous rocks, and is distinguished by the two characteristic fossils, the *Pentremite* and *Archimedes*, and by its oolitic structure. It constitutes the only remarkable difference of the rocks of Indiana from those of Ohio, the latter having instead a conglomerate from forty to eighty feet thick succeeding the Waverly sandstone rock, and the former a series of limestone some two hundred or three hundred feet thick, with a great variety of fossil remains."

The view here presented of the rocks of Indiana and Ohio, indicates, we think, 1. That they were once continuous and unbroken, as the blue limestone now is, which is the base of the whole. If this be so—2. That they were deposited upon a base originally higher at about the junction of the two states, or there has been subsequently a local elevation at this point. 3. The inclination of the strata as given by Dr. Locke, in a colored map and section of Adams county, would carry the top of the coal strata of Scioto, (the next county east,) if continued to the west line of Adams county, to a height of eleven hundred and sixty feet above it, and if they be continued to the longitude of Cincinnati, say fifty one miles west, "at the rate of one hundred feet in three miles" ascent, they would lie at an elevation above low water mark of the Ohio, of nearly three thousand four hundred feet. 4. Granting these particulars, or that only a portion of the rocks were continuous, the only authorized explanation of their absence, is a grand denudation by diluvial causes, which have operated in the general direction of this anticlinal axis of the blue limestone, and reduced this extensive area to one of a nearly uniform elevation. The immense diluvium on the Ohio, and in all the northern part of Indiana and Illinois ; the bowlders of primitive rocks ; the masses of native copper in Indiana ; the buried trees of Ohio, all indicate a mighty current from the northward, that has modified most remarkably the contour of the whole country.

The history of the agencies that have operated on this continent to give it its present face, can never be completely written from a comparison of the various elevations of the different parts, but the evidence presented by stratification, diluvium, and other geological resemblances, will, on the contrary, do far more to elucidate this subject, if it do not clear it up entirely.

III. *Second Annual Report of the State Geologist of the State of Michigan ; made to the Legislature, Feb. 4, 1839.*

The deficiency of maps of this state is so great that it is impossible to appreciate or understand much of the topography of its northern and unsettled portion, and much of the minute evidence on which the geological conclusions are based, is withheld for the final report. In general, the rocks of the northern part of the state belong to the carboniferous group, and "in this respect coincide with those heretofore described as occupying the southern counties, though their position in the series is very different."

"They consist of a succession of limestones, with intervening shales, sandstones, and clays, and at the northern extremity of the peninsula, the limestone is shattered in a manner similar to that seen in the sandstone in the southern counties."

The direction of all the rocks is northeast and southwest. Saginaw Bay, on Lake Huron, lies in the line of bearing, its southern shore being sandstone, and its northern limestone, both of which may be traced across southwesterly to lake Michigan. The limestone is observed at numerous points going north, at times so silicious as to render it unfit for burning, and again "containing large quantities of imbedded chert," and it constitutes the island of Mackinac, and several others in the vicinity, and rises from one hundred and fifty to two hundred and nineteen feet above the lake.

It "consists of an irregular assemblage of angular fragments, united by a tufaceous cement," and is not, as has been supposed by some, a "conglomerate,"—but "the rock occupies, no doubt, very nearly its original relative position, and its present condition may be ascribed to an uplift of the strata, subsequent to its complete induration, and the fragments have been imperfectly cemented together." This rock is regarded by Prof. Shepard, (Am. Jour. Vol. xxxiv, p. 144,) as the magnesian limestone of Illinois and Wisconsin, which near Rockwell, (p. 154,) "almost exactly resembles the metalliferous limestone of Missouri, having its peculiar buff color, and like it embracing silicious seams and nodules."

Its inclination is northwest. In following the eastern shore of Lake Michigan, the limestone continues the foundation rock. In a future notice we hope to be able to give a more exact account of the geology of the state.

Art. XV.—*The Daguerreotype and its Applications;* by W. H. Goode, late Chem. Assist. in the Univ. of New York.

Soon after the introduction of the Daguerreotype into this country, a number of persons occupied themselves with this method of obtaining photogenic pictures. As, however, all the manipulations were to be learned from the printed account of the process, a variety of experiments were performed with a view to its abridgment; some of which led to important results. The apparatus has been improved; the process itself, changed in one essential particular; and important applications have been made of this beautiful art. A sketch of these improvements and applications may not be uninteresting.

Pictures of the largest size—eight inches by six—are taken with the French achromatic lenses, perfect throughout; the parts within the shade are brought into view, distant objects are perfectly delineated. A common spectacle lens, an inch in diameter, of fourteen inches focal length, adjusted by means of a sliding tube, into one end of a cigar box, answers very well to take small pictures. In one respect, these pictures are equal to those obtained with the achromatics; they are, however, inferior in others, and in their general effect. The fine lines and edges of objects are exceedingly sharp and distinct; but the parts within the shade are not copied, and objects very distant from that to which the focus was adjusted, are not accurately delineated. By placing a diaphragm before the lens, with an aperture half an inch in diameter, the sharpness and distinctness of the lines and edges of objects are increased. In using this apparatus, which recommends itself by its cheapness—costing about twenty-five cents—the tube should be pushed in $\frac{2}{10}$ or $\frac{3}{10}$ inch, after adjusting the lens to the luminous focus, to obtain that of the chemical rays. The exact distance the tube is to be retracted should be determined for each lens by trial.

The folding doors of the French camera do not perfectly protect the iodized plate, nor can they be always opened and closed with promptitude. To obviate the inconveniences and risks occasioned by them, another contrivance, which dispenses with the use of doors, has been adopted for shielding the iodized surface from the action of light. The clean plate is placed and secured in a frame fitted to the back of the camera; this frame is grooved so as to allow a piece of tin to slide like the lid of a paint box in front of the silver surface. A narrow crevice is left in the camera when the tin is withdrawn, which may be closed by a piece of wood adapted to it, and attached by hinges to the side of the camera.

Another frame, similar to that just described, carries the ground glass. These frames should be so constructed that the ground glass and the plate shall occupy exactly the same position when one replaces the other. Instead of the deep iodine box which accompanies the French apparatus, one two inches deep, but much larger in every direction than the plate, is now commonly used. Iodization, however, can be effected with greater uniformity by placing the frame containing the plate on a board impregnated with iodine, than by any other arrangement. The moisture which collects in the box, should be removed by sulphuric acid, a cup of which should remain in it. If this precaution is neglected, a film of water condenses on the plate, and is fatal to the success of the operation.

An inclination of 45° is ordinarily given to the plate when it is exposed to the vapor of mercury, to allow the proof to be examined as it comes out. A convenient mercurializing apparatus for small plates, may be made by covering a large capsule containing a small quantity of mercury, with a piece of paste-board, with an aperture in it of the size and form of the plate. The mercury should be raised to about 140°, and the paste-board laid in its place. The frame containing the plate which has received the image, should then be placed horizontally over the aperture and the slide withdrawn. I have employed an apparatus of this description very successfully; and have found it advantageous to separate the plate farther from the mercury than the depth of the capsule; for this purpose, a paste-board box, open at both ends, two or three inches in length, and a little larger than the aperture, may be placed over it to support the frame. The proof will appear in five or ten minutes.*

Most if not all of these modifications of the Daguerreotype apparatus were first effected by Professors Draper and Morse of the University of New York.

Plates for Daguerreotype purposes are either of American manufacture, or they are imported from France. American plates are exceedingly imperfect. The silver abounds with perforations, which appear as black dots in the pictures; it also assumes a yellow instead of a white coat in burning.

A method has recently been published by Dr. Garlick, of plating brass or copper, which probably will remedy many of the difficulties now encountered in procuring plates of a good quality. In using these plates, the usual routine of cleaning, burning, &c. is unnecessary.

A piece of brass, or of planished copper—brass is preferred—is perfectly polished and its surface made perfectly clean. A solution of nitrate of silver, so weak that the silver is precipitated slowly, and of a brownish color, on the brass, is laid uniformly over it, "at least three times," with a camel's hair pencil. After each application of the nitrate, the plate should be rubbed gently in one direction, with moistened bitartrate of potassa, applied with buff. This coat of silver receives a fine polish from peroxide of iron and buff. Proofs are said to have been taken on it, comparable with those obtained on French plates.

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* Mr. H. L. Smith of Cleveland, Ohio, is in the habit of employing the vapor of mercury spontaneously given off from amalgamated copper for bringing out the picture. If the amalgam is evenly spread on the copper surface, the iodized plate may be placed within half an inch of it; but if the mercury is in a fluid state, the iodized plate should be separated double that distance.

It has been stated that the method recommended by M. Daguerre for procuring a pure silver surface, might be abridged, and some of the steps omitted. Any omission, however, in this respect, is attended with risk to the success of the operation. A new plate must be ground to an even surface, polished, burnt, re-polished, washed with dilute nitric acid, rubbed with some dry and fine powder, and finished with dry cotton. Of the polishing powders usually employed, fine emery is the best to bring the plate to an even surface, and to remove the deep scratches, tripoli for polishing, and whiting to succeed the dilute acid.

In every stage, the rubbing of the plate should be performed transversely, and in the direction opposite to that in which it is to be held to view the picture. If the longer diameter of the plate is to be vertical, the polishing strokes should be parallel to the shorter diameter; and the reverse if the shorter diameter is to be vertical.

A re-application of the dilute nitric acid, and of the whiting, is necessary if the plate is kept an hour or two before it is iodized. It should also, after having been exposed to the mercurial vapor, be re-polished and burnt before it is again employed, to evaporate any mercury that may adhere to its surface, but more particularly, to prevent the reappearance of the first proof along with the second.

If the iodization has been carried beyond the golden yellow, the coat is less sensitive; the proof is also liable to be stained by the light which is reflected from the plate itself, to the lens, and to the sides of the camera, and which is reflected back again indiscriminately over the iodized surface. Light of this color appears, after suffering these two reflections, to exert no influence on the sensitive coat in the period required to take a proof. Proofs can be obtained, if the iodization has been pushed to a reddish yellow, or verges to a violet tint; the shadows, however, are usually heavy, the fine lines are wanting, and the picture, if free from stains, has a coarse appearance.

Professor Draper has noticed a fact respecting iodized plates, which is essential to the success of the operation in this country. It appears that the sensibility of the iodized surface to the action of light, and the uniformity of that action, are increased by keeping the plate secluded from light for a certain period after iodization. The duration of this period of seclusion depends on the quality of the silver; a French plate requires to be kept half an hour; one of American manufacture, an hour or longer; and if it assumed a yellow coat in burning, it should not be placed in the camera for several hours.

The possibility of obtaining impressions on an iodized surface in any kind of weather, has been amply demonstrated. Generally, however, to obtain proofs successfully, a dry atmosphere, a pure white light, and a clear blue sky, are required. Attempts made to obtain them the day after one of rain,—when snow is melting rapidly,—or when the sun's light is of a yellowish tint, will generally be fruitless. The proofs taken with the light of a yellowish cast, are frequently black.

In removing the sensitive coat, care should be taken not to employ the same solution too long. If it remains unchanged, mercury is liable to be precipitated from it on the proof, producing unsightly spots. The method of removing the iodine introduced by Prof. Draper, is now generally abandoned, in consequence of the tarnishing of the proof after a time. The plate being placed in a weak solution of common salt, becomes one of the elements of a galvanic pair, if it is touched under the fluid with another metal. The iodine is apparently entirely removed by touching successively its corners with a clean piece of zinc. Distilled, or even rain water, is unnecessary in the last washing, if a little dexterity is employed in the manipulations. Immediately after pouring the water on the proof, one corner is dried in the flame of a spirit lamp; this is seized by a pair of forceps, and the plate held in an inclined position over the flame, the operator at the same time blowing over the surface of the plate. A film of water can in this way be made to traverse the whole length of the proof, leaving it free from stains or dirt. If any stain remains it will be on a corner, or an edge of the plate, and can be easily concealed by the mounting of the frame. A process has recently been employed in France which fixes the picture and changes its color; it also removes the unpleasant reflection from the silver surface, and renders the use of glass protectors unnecessary. A gramme of neutral chloride of gold, and three grammes of hyposulphite of soda, are dissolved in half a litre of water, i. e. one pint. The plate having the view on it, supported by a wire frame, has some of the liquid poured evenly over its surface; heat is then applied from below by a spirit lamp, with a large wick. The view presently turns dark; it should then be removed and well washed and dried. This process, it is said, has been repeated in New York, and found to answer these purposes.

The most important application of which this art was susceptible—taking portraits from life, to which it owes its chief interest—was made about the same time by Prof. Draper and by Mr. Wolcott, a mechanician of the city of New York. Neither possessed any knowledge of the views of the other; and results similar in character were obtained by each operator, but under circumstances differing slightly. Prof. Draper employed a Daguerreotype apparatus, the lens of which was four inches in aperture; Mr. Wolcott substituted an elliptical mirror of seven inches aperture, in place of the lens.

In taking Daguerreotype portraits, the camera operation should be concluded before the features become wearied with one mode of expression. Lenses of large aperture, and light as intense as can be borne, tempered by an interposed pane of blue glass, are therefore employed to accelerate this part of the process.

The usual arrangement of lenses consists of two French achromatics, of about three inches aperture, placed a little apart in a tube, the united focal length of which is eight inches. A better combination is said to be made by employing three of these lenses. The barrel in which they are mounted should project three or four inches in front, to exclude the side lights from the camera.

Reflecting mirrors are required to obtain light of sufficient intensity, on the face, in the proper direction for copying all the features. One, or if more convenient, two large looking glasses are employed. With one, the time of the camera operation is one fourth shorter; if two are requisite, the first reflects the ray in nearly vertical lines to the second, which directs it to the face. The mirror which directs the ray should be placed a little above the sitter. The space about the eyes will then be illuminated and a small shadow cast from the nose.

The sitter should be brought forward from the background; his head being supported steadily in an easy position, by a staff and ring at the back of his chair, and so placed, that his shadow shall not be copied as a part of his person.

Two lines, one extending from the head of the sitter to the mirror, the other from the same point to the camera, should form an angle of about 10°.

The camera operation is usually completed in from 1*m.* to 2½*m.*; portraits however, have been obtained in 10*s*.

In Daguerreotype miniatures, moles, freckles and even hairs are copied with microscopic accuracy. The iris of a dark eye is sharp and distinct, and the white dot of light upon it, is given with surprising beauty. If the iris is of a light blue, it is liable to solarize, before the face and dress make any decided impression on the iodized surface. This minute accuracy is preserved in the very small miniatures, intended to be worn as ornaments. The general sharpness of the portrait is probably increased by a diminution of its size, and with the aid of a lens all the "individual peculiarities" may be discovered. By enlarging the dimensions of the portrait, this character is impaired, and entirely disappears when the face becomes two inches in length. See American Repertory for October, p. 209—Professor Draper's paper on this subject.

Mr. Wolcott's external arrangements are similar to those already described. If the sun's light is employed, the ray is directed by a looking glass to the sitter, whose eyes are defended by an interposed blue glass.

An elliptical metallic mirror seven inches in diameter, and of twelve inches focal length, is secured at the back of a box open at one end. Within this box, and near its open end, is placed the movable frame which supports the plate. In operating with this apparatus, the sitter should be about eight feet distant from the open end of the box; the plate with its iodized surface facing the mirror is then placed in the frame previously adjusted to the focus.

The time required for the camera operation varies from $\frac{1}{2}m.$ to $2m.$, if the sun's light and the mirror are employed; $3m.$ are necessary to its completion in diffused light.

In this apparatus the position of the plate between the sitter and the metallic mirror, limits its size. Originally this limit was two inches square; improvements however, have been made by Mr. Wolcott, which enable him to use them of larger dimensions.

This apparatus possesses some decided advantages over that fitted with lenses. Portraits can be taken when the sun is obscured by clouds, and the picture is not reversed; that is, the right and the left hand do not change places.

Mr. Ibbotson, of London, has succeeded in copying magnified images by artificial light. That from lime rendered incandescent by the flame of the oxyhydrogen blowpipe, is said to be sufficiently intense for this purpose, and produces the result in a shorter period than solar light.

I have taken proofs of microscopic objects magnified six hundred times, by receiving the image from a solar microscope on the iodized surface. Perfect pictures of the wings of insects and other small objects were thus obtained.

The attempts which have hitherto been made, to transfer the picture to paper, have been unsuccessful. In order that it may be less liable to injury, Dr. Berres, of Vienna, has published a method of etching it "*faintly*" on the silver. In London, by using the graver, the plate with the picture on it, has been converted into an engraving plate. Of course, after such rude usage none of the peculiar beauty and delicacy of the Daguerreotype picture, appeared in the engraving.

Medical College, New Haven, Dec. 17th, 1840.

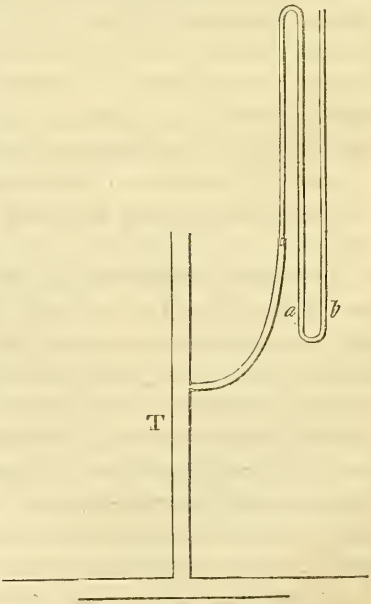
Art. XVI.—*Supplementary Note to the Article on the Pneumatic Paradox in the last number of this Journal*; by Joseph Hale Abbot, Mem. Am. Acad. Arts and Sciences, &c.

Since my article on this subject was forwarded to the editors, my attention has been drawn to a paper relating to the same phenomenon, by Mr. Thomas Hopkins, in the Memoirs of the Literary and Philosophical Society of Manchester, published in the year 1831; of the circumstances connected with its discovery, he gives the following account, undoubtedly authentic, and differing in some important particulars from that which I copied from the London Mechanics' Magazine :—

"On the 11th of October, in the year 1824, Mr. Roberts affixed a valve to the aperture of a pipe, used as a waste-pipe, for the purpose of regulating or equalizing the force of a blast of air, which was blowing a furnace. To his surprise, however, he found that the valve, instead of being readily blown off by a strong current, remained at a small distance from the aperture of the pipe, and was removed to a greater distance only by a considerable exertion of the power of the hand. This singular phenomenon was witnessed by many gentlemen belonging to this society, in the same week, and appeared to be viewed by them all, as equally new and extraordinary."

I have to regret that, from the circumstance of finding erroneous explanations of the phenomenon in foreign scientific publications of recent date, I was led, without further inquiry, to describe as new, several results, which, as I have since learned, had been previously discovered. Mr. Hopkins, and, previously to him, Mons. Clément-Désormes, in a memoir presented to the French Academy of Sciences, have anticipated me in proving the existence of a partial vacuum between the disks. An account of some experiments by Dr. Faraday, for a knowledge of which I am indebted to Prof. Henry, is contained in the third volume of the Quarterly Journal of Science, and among them are two or three similar to some of the less important ones described by me. Thus far I feel called upon to disclaim any pretensions to priority of discovery.

All of these gentlemen, if I understand them aright, attribute the adhesion of the disks solely to what I have called the *primary* rarefaction, produced by the lateral expansion of the radiating currents, in consequence of their "passing from a smaller to a larger space." From their failure to discover what I have termed the *secondary* rarefaction, the theory adopted by them seems to me essentially defective. It affords no explanation of the fact that, as the experiment is usually performed, the air is rarefied inward to the very orifice of the tube, where no expansion of the radiating currents can have taken place, and, in certain circumstances, four inches and a half into the tube itself. The latter singular result was obtained in the following manner.



To the perforated center of a plate of tinned sheet iron was soldered, as represented in the accompanying figure, a tube eight inches long, and a quarter of an inch in diameter. Holes were made at intervals in it, and to them were soldered small leaden tubes, a few inches long, to which a glass tube, bent in the form of a double syphon, could readily be adapted. Only one of them is seen in the figure. A disk of thin, varnished card, four inches in diameter, being placed underneath, and, by means of three small pins thrust through it near the edge, separated from the plate as far as possible without ceasing to be sustained, namely, four tenths of an inch, on blowing strongly through the tube, the colored water rose in the branch *a* of the glass tube four inches above its level in the branch *b*, showing the air in the tube T at the place of junction of the leaden tube, four inches and a half above the tin plate, to be rarer by about a hundredth part, than the surrounding atmosphere. In a similar manner, the air in any part of the tube nearer the plate, is found to be rarer, and, in any part farther from it, to be denser than the surrounding atmosphere. These results can be explained only by referring them to a kind of retrograde influence of the primary rarefaction. The current in the lower part of the tube, meeting with diminished resistance, in consequence of the attenuated state of the air between the disks, rushes forward with greater velocity than that with which it issues from the mouth; and this acceleration of velocity, producing a *secondary* rarefaction, extends the limits of the primary *inwards*, as just shown, and *outwards* by increasing the momentum of the radiating currents.

Boston, December 16, 1840.

Art. XVII.—*Miscellaneous Observations on Insects, &c.*; by Dr. John T. Plummer, of Richmond, Indiana, in letters to the Editors, dated Aug. 11, and Dec. 12, 1840.

Without the advantage of systematical works, in a desultory way, I have long been a deeply interested observer of the habits and various developments of living insects, and have witnessed many curious phenomena pertaining to them. My botanical researches, prosecuted over hill and dale, through wet and dry, for the last fourteen years, have often brought me into contact with those diminutive specimens of creation, the insect tribes, and have thus, no doubt, presented some things to my view, which otherwise I should not have seen. Last summer I picked a dozen recently fallen plums from beneath one of my trees, and placed them in a glass jar, one half filled with earth, for the purpose of learning the progress, and indeed, the character of the curculio, with the larvæ of which this fruit was obviously infested. I had never seen the perfect insect. In a few days, the larvæ forsook the plums, and penetrated the contained earth. I did not expect to see any thing more of them till next spring; but on casually looking at the jar about a month afterward I was greatly surprised to find that my prisoners had put off their old clothes, and assumed a quite different appearance. They had of course retired below merely to change their dress ; but I did not expect them to get through with the duties of the toilet so soon. They were now (eighteen or twenty of them) ready to effect their escape through the gauze with which I had covered the vessel. They manifested much sagacity ; a strong light would arrest all their motions ; and when the jar was struck, they would instantly fold up their little limbs, and remain for a considerable time motionless and attached to the gauze, or drop to the earth below like an inanimate thing. In a faint light they were "nimble as a bug," traversing the jar in all directions, but especially going upwards, tumbling down, and returning to the top. I separated two of them, and placed them with a sound plum, in another glass vessel, to witness the manner of their depredation upon the fruit. They lost no time in mounting the plum, and preying upon it ; but instead of the usual incision for the deposit of an egg, they feasted upon it, making a broad area where they fed. I am trying a similar experiment with the "fly," which has been sadly mischievous this year in our neighborhood, attacking in some instances the rye and barley as well as the wheat.

What a difference there is in the retentiveness of life in different insects ! A large coleopter I could not destroy by several days confinement in carbonic acid gas : after this trial I subjected it for hours, to strong ammoniacal gas, with no perceptible effect ; and starvation afterward for several weeks, was not fatal to it. (It forcibly reminded me of some "bots" upon which I tried experiments many years ago : I could not succeed in killing them by any of the powerful agents to which I exposed them, till I covered them with sulphur and set fire to it.) On the other hand, some neuroptera perished in ten hours by confinement in common air. A *Lepisma saccharina* was placed in a vessel with a small, green, trigonal shaped or more properly triquetrous Gryllus : the latter in twenty four hours was exceedingly feeble, and soon after died ;

the former, after a number of days, (six or eight,) was as much a flirt as ever, wriggling and flouncing at every touch.

December 12, 1840.—In a former letter, I contrasted the vital tenacity of a Lepidium, with that of a common fly. The Lepidium is still alive. It has been kept since the date of that letter as it had been before, in a perfectly clean cupping glass, covered with another cupping glass, so that to human perception, life has been sustained without subsistence for many months. The continuance of the insect's existence is in no degree due to a state of torpidity during this cold weather.

In the summer, the larvæ of the lady-bug, (slate-colored wings with sixteen black dots, the two near the neck approximate,) were very numerous about my residence, and attached themselves, after their aphidivorous career, to the trees, walls and other neighboring objects, by their posterior extremity. The little birds stole away many of them; but others were well ensconced, and they fell to my share. Thus adherent, the larvæ struggle by occasional jerks, for several days, to disengage themselves from their envelope. At last a buff-colored, elliptical and rugose thing appears, the old integument having been slipped down into a dense mass; and in twelve hours, the black spots appear upon its partially developed wings. It remains firmly fastened to its original point for a day or two longer, when another integument is thrown off as before, and the perfect bug walks forth. It does not immediately leave the spot; but remains a long time in the vicinity of its exuviæ, perambulating around them as if exulting at its escape from so mean a habitation. These larvæ are covered with spines. In several instances, those that were so unfortunate as to have attached themselves early, were attacked by those still at liberty, and destroyed: the prisoner showed by his contortions, &c., that he suffered from the wound. I saw one of the semi-developed bugs destroyed in the same manner; and one of the *perfect* bugs preying upon an attached larva. Thus voracity continues through all the stages of its metamorphosis: the larva living upon its own grade, and the winged bug, upon the larvæ.

Motion of Particles on Melted Spermaceti.—In relation to some remarks in a former number of this Journal, Vol. xxxiii, p. 198, on a singular phenomenon in a burning candle, in which a particle floating upon the melted spermaceti, alternately approached to and was repelled from the wick, the ends being invariably reversed in changing its course, I observe that having repeatedly examined other candles, I have not been able to discover any thing more than the ordinary capillary attraction in them; and am led to believe the repulsion in the case cited, was owing to an accidental evolution of minute bubbles of gas at the base of the exposed wick. I am strengthened in this opinion, by having observed some time ago a similar phenomenon in an ash-hopper while in operation, in which the cause was obvious; the calm, supernatant water, appeared to be very gently directed to several little vertices, bearing thither fragments of coal, &c.; as soon as they reached the center, a small bubble of air arose in that spot; and bursting, caused the particles adjacent to wheel about and retreat.

Tooth and Grinder of a Mastodon.—The grinder of a *Mastodon?** and the tusk of an Elephant have been found in this State; the first sixteen, and the second thirty miles from this place. The tusk was disinterred from a bed of gravel: it must have been originally at least six feet in length. Both specimens are now in our "Atheneum."

ART. XVIII.—*On Terrestrial Magnetism;* by JOHN LOCKE, M. D., Professor of Chemistry and Pharmacy in the Medical College of Ohio.

Medical College of Ohio, Nov. 20, 1840.

TO THE EDITORS.

You are already apprised that there was an erratum in my last manuscript, published in Vol. xxxix, p. 319, of this Journal, making an apparent disagreement in the results by the two dipping needles at Davenport, in Iowa, amounting to 6′.75. As the object of that communication was to show that the separate results ob-

* Dr. Plummer's mark of interrogation, implies a doubt which we presume will be easily removed by an examination of the tooth; if of an elephant, it should have low processes and the enamel bounding them should extend vertically through from top to bottom; if of the mastodon, the processes will be high and strong, and the enamel only superficial over the entire tooth.—SEN. ED.

tained by the two needles seldom differed more than *one minute*, I deem it essential to correct the error by copying below the entire minutes of the observation at that place.

Davenport, Iowa Territory, Sept. 15, 1839. *Lat.* 41° 30′ *N.*, *Lon.* 90° 18′ *W.*

Needle No. 1. B North.			Needle No. 2. B North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	72°55′	E.	E.	71°58′
W.	W.	70 47	W.	W.	72 02
W.	E.	72 47	W.	E.	71 54
E.	W.	71 06	E.	W.	72 03
	A North.			A North.	
E.	E.	70 59	E.	E.	72 16
W.	W.	72 52	W.	W.	71 26
W.	E.	70 53	W.	E.	72 12.5
E.	W.	72 57	E.	W.	71 28.5
		8)575 16			8)575 20
		Mean, 71 54.5			Mean, 71 55

I will here add some observations made on the dip in Ohio, Indiana and Kentucky, within the last three months. The region over which these observations have been extended, embraces rather more than two degrees of latitude and three degrees of longitude. Dip, intensity, and declination, were all made the objects of inquiry, but I here communicate only what relates to the dip, especially to show the close agreement of the results of the two different needles.

No. 1. *Piqua, Ohio, Lat.* 40° 06′ *N.*, *Lon.* 84° 10′ *W.* *Aug.* 22, 1840.

Needle No. 1. A North.			Needle No. 2. B North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	70°40′	E.	E.	71°47′
W.	W.	72 34	W.	W.	71 33.5
W.	E.	70 43	W.	E.	71 46
E.	W.	72 30	E.	W.	71 31.5
	B North.			A North.	
E.	E.	72 44	E.	E.	71 38.5
W.	W.	70 33.5	W.	W.	71 23.5
W.	E.	72 42	W.	E.	71 39.5
E.	W.	70 24	E.	W.	71 23.5
		8)572 50.5			8)572 43
		Mean, 71 36.31			Mean, 71 35.375

No. 2. *Dayton, Ohio, Lat.* 39° 44′ *N., Lon.* 84° 07′ *W. Aug.* 21, 1840.

Needle No. 1. B North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	72°34′	E.	E.	71°23′.5
W.	W.	70 12	W.	W.	71 11
W.	E.	72 28	W.	E.	71 25.5
E.	W.	70 05	E.	W.	71 07
	A North.			B North.	
E.	E.	70 25	E.	E.	71 29
W.	W.	72 19	W.	W.	71 29
W.	E.	70 20	W.	E.	71 25
E.	W.	72 32.5	E.	W.	71 26
		8)570 55.5			8)570 56
		Mean, 71 21.937			Mean, 71 22*

No. 3. *Hamilton, Ohio, Lat.* 39° 23′ *N., Lon.* 84° 32′ *W. Aug.* 20, 1840.

Needle No. 1. A North.			Needle No. 2. B North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	70°15′	E.	E.	71°08′.5
W.	W.	71 54.5	W.	W.	70 59
W.	E.	70 06.5	W.	E.	71 12.5
E.	W.	71 53.5	E.	W.	70 59
	B North.			A North.	
E.	E.	72 00	E.	E.	70 56.5
W.	W.	70 00	W.	W.	70 51
W.	E.	71 50	W.	E.	70 59
E.	W.	69 58	E.	W.	70 51.5
		8)567 57.5			8)567 57
		Mean, 70 59.687			Mean, 70 59.625

No. 4. *Lebanon, Ohio, Lat.* 39° 26′ *N., Lon.* 84° 6′ *W. Aug.* 24, 1840.

Needle No. 1. A North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	70°11′	E.	E.	71°06′.5
W.	W.	72 07	W.	W.	70 38.5
W.	E.	70 05.5	W.	E.	71 01.5
E.	W.	72 08	E.	W.	70 52
	B North.			B North.	
E.	E.	72 02.5	E.	E.	71 25
W.	W.	70 00	W.	W.	71 04.5
W.	E.	71 52.5	W.	E.	71 10
E.	W.	70 01	E.	W.	71 07.5
		8)568 27.5			8)568 25.5
		Mean, 71 03.437			Mean, 71 03.187

* Dip at Dayton, in March, 1838, 71° 22′.75.

No. 5. *Mason, Ohio, Lat.* 39° 22′ *N., Lon.* 84° 13′ *W. Aug.* 25, 1840.

Needle No. 1. B North.			Needle No. 2. B North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	72°03′	E.	E.	71°04′
W.	W.	69 40.5	W.	W.	70 57
W.	E.	71 49	W.	E.	71 05
E.	W.	69 48	E.	W.	70 55
	A North.			A North.	
E.	E.	70 00	E.	E.	71 05
W.	W.	71 57	W.	W.	70 38.5
W.	E.	69 56.5	W.	E.	70 51.5
E.	W.	71 59	E.	W.	70 38.5
		8)567 13			8)567 14.5
		Mean, 70 54.125			Mean, 70 54.312

No. 6. *Cincinnati, Ohio, Lat.* 39° 6′ *N., Lon.* 84° 27′ *W. Aug.* 26, 1840.

Needle No. 1. A North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	69°25′	E.	E.	70°31′.5
W.	W.	71 29.5	W.	W.	70 11.5
W.	E.	69 26.5	W.	E.	70 33
E.	W.	71 33	E.	W.	70 13
	B North.			B North.	
E.	E.	71 40	E.	E.	70 32.5
W.	W.	69 16	W.	W.	70 35
W.	E.	71 27	W.	E.	70 32.5
E.	W.	69 23.5	E.	W.	70 37
		8)563 40.5			8)563 46
		Mean, 70 27.56			Mean, 70 28.25

No. 7. *Williamstown, Kentucky, Lat.* 38° 36′ *N.? Lon.* 84° 30′ *W.? Sept.* 1, 1840.

Needle No. 1. B North.			Needle No. 2. B North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	71°13′	E.	E.	70°12′.5
W.	W.	68 55.5	W.	W.	70 14.5
W.	E.	71 09.5	W.	E.	70 11
E.	W.	68 55	E.	W.	70 15
	A North.			A North.	
E.	E.	68 58	E.	E.	69 53
W.	W.	71 10.5	W.	W.	69 58.5
W.	E.	68 59	W.	E.	69 53
E.	W.	71 11.5	E.	W.	69 56.5
		8)560 32			8)560 34
		Mean, 70 04			Mean, 70 04.25

No. 8. *Lexington, Kentucky, Lat.* 38° 6′ *N., Lon.* 84° 18′ *W. Sept.* 2, 1840.

Needle No. 1. B North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	71°05′	E.	E.	69°40′.5
W.	W.	68 40	W.	W.	69 53.5
W.	E.	71 05	W.	E.	69 46
E.	W.	68 38	E.	W.	69 49.5
A North.			B North.		
E.	E.	68 55	E.	E.	69 65.5
W.	W.	70 58	W.	W.	69 53.5
W.	E.	69 06	W.	E.	69 68.5
E.	W.	70 49	E.	W.	69 59.5
		8)559 16			8)559 16.5
		Mean, 69 54.5			Mean, 69 54.562

No. 9. *Clay's Ferry, Kentucky River, Lat.* 37° 53′ *N., Lon.* 84° 18′ ? *W. Sept.* 3, 1840.

Needle No. 1. B North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	70°48′	E.	E.	69°47′.5
W.	W.	68 45	W.	W.	69 38.5
W.	E.	70 47	W.	E.	69 52.5
E.	W.	68 41	E.	W.	69 38.5
A North.			B North.		
E.	E.	68 49	E.	E.	69 44
W.	W.	70 53	W.	W.	69 56.5
W.	E.	68 48	W.	E.	69 46.5
E.	W.	70 53.5	E.	W.	69 59.5
		8)558 24.5			8)558 23.5
		Mean, 69 48.06			Mean, 69 47.937

At the above locality, Professors Peter and Alvord, of the Transylvania University, were present and read the indications with me.

No. 10. *Frankfort, Kentucky, Lat.* 38° 14′ *N., Lon.* 84° 40′ *W. Sept.* 4, 1840.

Needle No. 1. A North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	68°48′	E.	E.	69°58′.5
W.	W.	71 02	W.	W.	69 34
W.	E.	69 00	W.	E.	70 04
E.	W.	70 58.5	E.	W.	69 35.5
B North.			B North.		
E.	E.	71 03	E.	E.	70 04.5
W.	W.	68 43	W.	W.	69 48.5
W.	E.	71 06	W.	E.	70 05.5
E.	W.	68 41.5	E.	W.	70 03.5
		8)559 22			8)559 14
		Mean, 69 55.25			Mean, 69 54.25

No. 11. *Louisville,* Kentucky, Lat.* 38° 3′ *N., Lon.* 85° 30′ *W. Sept.* 7, 1840.

Needle No. 1. A North.			Needle No. 2. B North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	68°56′	E.	E.	70°17′.5
W.	W.	71 23	W.	W.	70 06.5
W.	E.	68 52	W.	E.	70 14.5
E.	W.	71 22	E.	W.	70 10
	B North.			A North.	
E.	E.	71 18.5	E.	E.	70 03.5
W.	W.	68 40	W.	W.	69 48.5
W.	E.	71 20	W.	E.	70 06.5
E.	W.	68 42	E.	W.	69 47.5
		8)560 33.5			8)560 34.5
		Mean, 70 04.19			Mean, 70 04.31

No. 12. *Mount Vernon, Indiana, Lat.* 37° 59′ *N., Lon.* 87° 47′ *W. Sept.* 10, 1840.

Needle No. 1. A North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	67°58′	E.	E.	68°59′
W.	W.	70 05.5	W.	W.	68 36
W.	E.	67 56.5	W.	E.	68 56
E.	W.	70 09	E.	W.	68 38
	B North.			B North.	
E.	E.	70 04	E.	E.	69 04.5
W.	W.	67 38.5	W.	W.	69 03
W.	E.	70 04	W.	E.	69 13.5
E.	W.	67 35	E.	W.	69 00
		8)551 30.5			8)551 30
		Mean, 68 56.31			Mean, 68 56.25

* The above observations were made on Corn Island, in the Ohio. At Jacob's Woods, two miles south of the island, the dip was 69° 57′.1.

On August 31, 1839, the dip on Corn Island was . .	70° 08′
Sept. 7, 1840, " " " . .	70° 04′
March 11, 1840, the dip at Jacob's Woods was .	69° 57′
Sept. 7, 1840, " " " .	69° 57′

The above exhibits the greatest change of dip which I have ever noticed in so short a distance as two miles.

No. 13. *New Harmony, Indiana, Lat.* 38° 11′ *N., Lon.* 87° 48′ *W. Sept.* 11, 1840.

Needle No. 1. B North.			Needle No. 2. B North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	70°17′	E.	E.	69°15′
W.	W.	67 43	W.	W.	69 11.5
W.	E.	70 19.5	W.	E.	69 13.5
E.	W.	67 40	E.	W.	69 23.5
A North.			A North.		
E.	E.	67 58	E.	E.	69 02
W.	W.	70 18.5	W.	W.	68 56.5
W.	E.	67 55	W.	E.	69 00
E.	W.	70 18	E.	W.	68 53
		8)552 29.0			8)552 55
		Mean, 69 03.62			Mean, 69 06.87
2d observation,		69 02.3	2d observation,		69 06.8
3d do.		69 03.62	3d do.		69 06.8
		3) 9.54			3) 24.7
Mean of 24 obs.		69 03.18	Mean of 24 obs.		69 06.82

In the above observations, it appears that each needle, while it gave by repeated observations results consistent with itself, differed obstinately from the other to the amount of near four minutes.

No. 14. *Princeton, Indiana, Lat.* 38° 23′ *N., Lon.* 87° 30′ *W. Sept.* 16, 1840.

Needle No. 1. A North.			Needle No. 2. B North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	68°07′.5	E.	E.	69°35′
W.	W.	70 45.5	W.	W.	69 25.5
W.	E.	68 04	W.	E.	69 29.5
E.	W.	70 39.5	E.	W.	69 30.5
B North.			A North.		
E.	E.	70 40	E.	E.	69 27
W.	W.	68 00	W.	W.	69 05
W.	E.	70 35	W.	E.	69 27
E.	W.	68 07	E.	W.	69 03
		8)554 58.5			8)555 02.5
		Mean, 69 22.31			Mean, 69 22.81

No. 15. *Vincennes, Indiana, Lat.* 38° 43′ *N., Lon.* 87° 25′ *W. Sept.* 18, 1840.

Needle No. 1. B North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	71°10′.5	E.	E.	69°52′
W.	W.	68 25	W.	W.	69 40.5
W.	E.	71 06	W.	E.	69 52.5
E.	W.	68 31.5	E.	W.	69 50
A North.			B North.		
E.	E.	68 46.5	E.	E.	69 56.5
W.	W.	71 03	W.	W.	69 56
W.	E.	68 36	W.	E.	69 50
E.	W.	71 11.5	E.	W.	69 63
		8)558 50			8)559 00.5
	Mean,	69 51.25		Mean,	69 52.56

No. 16. *Paoli, Indiana, Lat.* 38° 35′ *N., Lon.* 86° 25′ *W. Sept.* 20, 1840.

Needle No. 1. A North.			Needle No. 2. A North.		
Face of instrument.	Face of needle.	Dip indicated.	Face of instrument.	Face of needle.	Dip indicated.
E.	E.	68°30′	E.	E.	69°30′
W.	W.	70 47.5	W.	W.	69 26.5
W.	E.	68 30	W.	E.	69 34.5
E.	W.	70 45.5	E.	W.	69 25
B North.			B North.		
E.	E.	70 47	E.	E.	69 37
W.	W.	68 12	W.	W.	69 41.5
W.	E.	70 49	W.	E.	69 39.5
E.	W.	68 21	E.	W.	69 51.5
		8)556 42			8)556 45.5
	Mean,	69 35.25		Mean,	69 35.68

The close agreement of the results of these two needles, will undoubtedly surprise experimenters on magnetism. They are much nearer to identity than at first I had hoped to bring them. The desirable object has been accomplished partly by a fine instrument, and partly by peculiar manipulations, which, when I have perfected, I shall communicate to the public.

Art. XIX.—*Electrography or the Electrotype.**

Instructions for the Multiplication of Works of Art in Metal by Voltaic Electricity; by Thomas Spencer. (Part IV of Griffin's Scientific Miscellany: Glasgow, 1840, pp. 62.)

It is now about three years since we were first informed in the public prints, that Prof. Jacobi, of St. Petersburg, had succeeded in producing lines of metallic copper in relief, upon plates of the same metal, by precipitation from the solutions of the sulphate of that metal, by aid of Voltaic electricity.

Since that time very many experiments have been instituted on the subject, all having the same object in view, viz. the production of perfect metallic casts or copies of medals, copper-plates, and other works of art. But no one has attained the object more perfectly or by more simple means than Mr. Spencer, of Liverpool, whose attention was called to this subject before any thing was known by him of what Prof. Jacobi had done. We do not pretend to give an opinion as to the priority of claim which either of these gentlemen may have to the process in question, since we deem it quite possible that each may have pursued his own researches, both leading to the same result, without any knowledge of what was doing by the other; and without the slightest intention of interference.†

The conditions necessary to the success of this process are the following. 1. Two fluids, one of which must be a saturated solution of the salt, on the negative side of a Voltaic series; the other may be, either water slightly acidulated with sulphuric acid, or a weak saline solution, as sulphate of soda.

2. These two fluids must *be in contact without mixture*; this is effected by placing them in a vessel provided with a porous division, such as plaster of Paris, unglazed earthen ware, brown paper, bladder, calf-skin, or other animal membrane.

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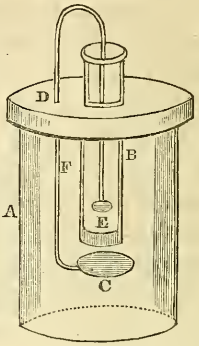
* Some of our readers may have been surprised, that we have not sooner given an account of this important art. We should have done so, but preferred to wait until we had time to go through ourselves with the process in all its details. We were reminded of our backwardness by receiving, through the kindness of the author, the work whose title stands at the head of this article, and have revised our experiments made many months since on this subject, and instituted others. Our experience will be found in the above notice of Mr. Spencer's pamphlet.

† In a Liverpool paper, we find an ardent vindication of Mr. Spencer's claim to priority and superior excellence in the results.

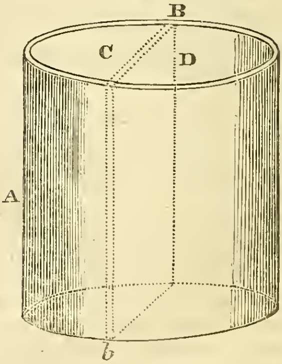
3. A connection must also be established between the two fluids by means of a metallic strap or wire; to the end of this strap which is in the metallic salt, must be soldered the object to be copied, which must also be a metal or at least have a metallic surface; to the other end of this metallic connection, which is in the acidulated water, a piece of zinc must be attached by soldering.

Fig. 1.



The accompanying figure taken from Mr. Spencer's pamphlet, will render the foregoing conditions of the experiment quite plain. A, is a glass vessel, (a common drinking tumbler answers very well;) B, is a straight tube of glass, in this case an argand lamp chimney, having the lower end closed by a diaphragm of plaster, brown paper, or animal membrane; C, the object to be copied; E, a piece of zinc; F, the copper connecting wire soldered to C and E; D, a cover of any convenient material, (a cork or piece of wood,) fitting A, and provided with two holes, one in the center for holding the glass B in its place and another to permit the wire F to pass. The apparatus being thus arranged, pour into A, a saturated solution of sulphate of copper warmed to 100° or 120° F., and into B, a warm weak acid water to the same level as the solution in the outer vessel.*

Fig. 2.



A more simple form of apparatus, and one which we have used with good success, is shown in the following figure; we describe it because we believe it is much better adapted to the means of the inexperienced experimenter than the foregoing, and its manipulation is also much simpler.

A, is an earthen ware pot of any requisite capacity; B, *b*, the porous division, which may be made by casting plaster of Paris across from side to side, and

* Mr. Spencer objects to the use of an apparatus where the plates are vertical, because the deposition is of unequal thickness; but we have found no difficulty if the solution is kept saturated.

its position and thickness may be regulated at pleasure, by two boards fitting the sides of the vessel and leaving the desired space between them; after the plaster has become firm, the boards may be withdrawn. Any of the substances before named will answer to form this division. C, D, the two chambers formed by the division B, *b*. Either of these may be devoted to the cupreous solution, and the other to the saline or acid water. The connecting wire will then form an arch between the two, supported by a strip of wood laid over the division. Mr. Joseph Saxton, of the United States Mint, showed us one of these little pots which had been sawn down by a stone-cutter's saw, in the line B, *b*, and into the slit so formed, a piece of calf-skin was inserted and the joint secured from leakage by a hoop of iron, fitted with a binding screw.*

These two forms of apparatus will be found quite sufficient to copy most objects of art except large engraved plates, which must be provided with a box suited to their form and dimensions.†

Being provided with such an apparatus as has been described, the next question is, how to make use of it in copying any object of art; to accomplish this, the experimenter must proceed as follows:—First, of metallic medals. A concave copy of the medal must be first obtained, either by fusible metal, or by impressing it on soft and bright sheet lead, in a press of sufficient power to strike up its most delicate lines boldly. This preliminary step is not indispensable, because the object to be copied may be at once immersed in the cupreous solution, and a deposit obtained on it, which must subsequently be removed, and used as a mould, in which to cast the relief; but it is obvious that twice the time is required in this way, to obtain the final copy, beside the danger of injuring the beauty of the medal by soldering the connection on it, however adroitly that operation may be performed; and the deposited copper is much more difficult to remove from a bed of the same metal, particularly if the matrix was itself the result of Voltaic casting. But in whatever manner the intaglio copy may have been obtained, before immersing it in the cupreous solution, all those parts of the surface not intended to be copied, must be covered with bees' wax or varnish, applied

* Mr. Saxton has by this mode, copied a Daguerreotype plate; the picture being visible by the difference of polish in the deposit. This is the strongest proof of the great delicacy of this process which has come to our knowledge.

† See Mr. Spencer's book, p. 47, for a good form of apparatus for this purpose.

with a brush, the mould being previously warmed slightly, so that the wax may be more evenly distributed. The wire connecting the mould with the zinc, must be soldered to the back of the leaden impress. No sooner are the poles of this small battery connected and placed in their respective solutions, than the deposit of metallic copper commences on the mould, copying with inconceivable delicacy, all the most minute lines and even the shades of polish which may be on the face of the matrix. Great care is necessary to see that the surface to be deposited upon, is clean and bright, for the least grease or foreign matter, even such as would come from the fingers, will prove an impediment to the uniformity and beauty of the result. From one day to three days are necessary, to obtain a copy of a medal or of any object of similar size, according to the required thickness of the deposit. During this time, the apparatus should be placed in a situation where the temperature can be maintained at about 100° or 120°, and the saturation of the cupreous solution should be carefully insured, by suspending in it a gauze bag containing crystals of the salt, which will be dissolved as the strength of the solution declines. If this latter precaution be neglected, the free acid resulting from the constant decomposition of the sulphate of copper will interfere materially with the success of the result, and the tenacity of the deposited copper, as well as the rapidity with which the process proceeds seems to depend in some measure, on the temperature being moderately elevated.

After the deposit has gained sufficient thickness, it may be easily removed by immersing the united metals in boiling water, or better by holding the matrix for a moment over a spirit lamp, or if large and heavy, over a chaffeur of burning coals, when the different expansibility of the two metals will cause an instant separation, with a smart crackling sound. The separation of the deposit, where it has fallen on a matrix of copper, is not however, so easy, but it may generally be effected without serious difficulty, if previously to placing the matrix in the solution, its warmed surface be slightly covered with fine bees' wax, which must then be removed with great care from all parts of it, while still warm, rubbing it briskly with a clean fine cloth, all the wax seems to be removed, but in fact, a film remains which is sufficient to prevent *chemical* union between the surfaces, although if carefully done, not interfering with the deposition of the metal. The casts thus obtained, have all the sharpness of the original, and may be bronzed in the usual way, to any color which may suit the taste of the experimenter.*

Engraved plates of copper may be copied with equal success by this method, and already this has become an important branch of the engraver's art,† and we hear of large and elaborate plates being thus multiplied to any desired extent. We should suppose that by availing ourselves of this advantage, the great expense of steel plates might be avoided. Such copies may be furnished at a price but little exceeding that of ordinary engraver's copper. Mr. Spencer says, that copies of engraved plates may be taken in lead, by pressure as before described, but we should doubt if large plates could be thus treated with success; and that the first copy ought to be in copper, which when once obtained will answer any number of times.

But the usefulness of this process would be much abridged were it applicable only to *metallic bodies.* Such however is not the case. Almost any non-conducting surface may be rendered a conductor by the following ingenious process, proposed by Mr. Spencer. Wash the surface to be metallized with nitrate of silver, by a camel's hair pencil, and then expose this surface thus treated to the vapors of phosphorus dissolved in alcohol or spirits of turpentine, which for this purpose should be placed in a capsule, and gently warmed by a spirit lamp, or over a sand-bath. Instantly the silver is reduced to a phosphuret, and covers the whole

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* A bronzing solution may be made by taking two parts of acetate of copper, and one of muriate of ammonia, and dissolving them in acetic acid (or vinegar;) boil the solution and add water until no longer any white precipitate falls, and only a slight metallic taste remains; filter it, and place the medal to be bronzed in a copper basin; pour the solution, while boiling, on the object, and keep up the ebullition for some time; examine the medal frequently, and when the desired shade of oxidation has been attained, remove it and wash it most carefully in several waters; otherwise a whitish film will subsequently come over it, injuring its appearance. The article to be bronzed must be previously cleaned bright, and be free from all greasiness.

† Beautiful examples of engravings thus obtained, appeared in the Westminster Review, for Septemper last, and side by side with them, impressions from the original plate. No difference could be perceived on the closest examination. Dr. Chilton, of New York, has also obtained equally good results, an example of which was given in the July number of Prof. Mapes' American Repertory. We may also add, that we have succeeded in copying a plate, (a head of John Bunyan,) six by nine inches, and that in some future number, we may give some examples, as occasion may require. The London and Edinburgh Philosophical Magazine and Newton's Journal, have also contained examples of this art.

surface, however delicate or intricate, with a thin metallic film, which will be found a good conductor. We have in this way obtained deposits on plaster, and even paper, and any one by availing himself of this fact may procure perfect fac-similes in copper of those beautiful reliefs of animals and plants, &c., on Bristol paper, by Dobbs of London. In doing this it is necessary to protect the back and sides of the plaster or paper by varnish, to prevent its absorbing water, and thereby injuring the sharpness of the copy.

We have thought that with proper care in the details, this mode might be with great advantage, applied to the production of copper busts and statues. For this purpose let a plaster mould be obtained, such as is used in the production of common plaster casts; let the individual parts of this mould be carefully treated, in the manner just described, to render their surfaces conductors; the mould may then be united, and all requisite care being taken to see that the joints are properly secured and closed, so as not to interrupt the conducting surfaces, let it be placed in a vessel of suitable form, and completely immersed in a solution of sulphate of copper, and treated in a manner similar to any other object under such circumstances. We regret that it is not in our power to say that we have done this, and we are not aware that any experiments on this point have been published.* If it can be done successfully, its value to the arts will be very great; furnishing the artist at once with the means of perpetuating his fame by a literal *monumentum œre perennius.*

This art has sprung up and grown to great perfection almost in a day; and we hear from every quarter, accounts of its application to new and valuable purposes. The art of printing seems likely to profit greatly by this new coadjutor. The type-founder can now fill his moulds with copper and thus obtain plates which will outlast their owners, while their superior hardness and durability will warrant the expenditure of much greater care and labor in finishing all their details.†

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* A plaster bust may, after proper preparation, be inclosed in copper by this mode; but the surface of the deposit, after attaining the thickness of stout paper, manifests, according to our observations, a tendency to rise up in grains like shot, and after a little, the sharpness of the inclosed plaster is lost; we doubt therefore if this modification of the process can ever be pursued with much hope of success.

† Mr. Spencer sent us with his pamphlet, a handsomely printed table in 8vo. from type thus produced.

The wood-engraver can now furnish blocks which will admit of much greater delicacy of finish, although it is doubtful if any material can endure the common press for a longer time than well prepared wood is stated to have done. But the ease and accuracy with which the most elaborate designs may be multiplied, will give this mode the preference.

The question very naturally arises, to what metals is this process applicable? We believe we are warranted by the present state of our knowledge, in stating that it has hitherto been applied *successfully* to copper alone, although no reasonable doubt can be entertained that modes will yet be discovered by which it can be profitably used with other metals. Platinum has been thus precipitated from its chloride, not in a useful form, but in the state of minute division, in a black powder, resembling spongy platinum. This result is the more to be regretted, since we are in great need of new and economical modes of working this invaluable metal. Gold and silver may be also thrown down from their respective chloride, and nitrate; but the film deposited is *very* thin, and may be removed by rubbing with the finger, and ceases to be deposited when the surface on which it is produced is *entirely covered.* We were indeed informed, a few months since, that M. De La Rive had furnished the artists of Geneva with a modification of this process, whereby they were able to gild spoons and other articles of silver successfully. But we understand that more was expected from it than has been realized. Lead may be treated in this way, but it is so readily worked in other modes, that it presents no object.

We have observed in numerous experiments on this subject, that not only the thickness of the porous diaphragm, but also the nature of its surface, influences the rapidity and character of the deposited copper. Thus in using a plaster division, formed in a stone pot, as shewn in fig. 2, by casting between two boards, the surfaces of the division became perpendicularly striated by the grain of the wood, and by little prominences on the lower end, as left by the saw. These striæ were apparent on the deposit, giving it the appearance which metals receive from the rolling cylinder—and they were very bold when the copper had attained the thickness of a dollar. Calf-skin gave no such result; on the contrary, the surfaces of deposits obtained with that substance as a division were quite smooth. Bladder-skin, undressed, causes the deposit to be pitted with little hollows and corresponding granulations over its whole surface, each inequality answering to a similar one on the membrane.

These facts may be important in the practical use of this art, where success depends on the beauty of the result.

Mr. Spencer remarks, that in these experiments the zinc should never be amalgamated, notwithstanding the great advantage of that mode of treating zinc in other Voltaic arrangements. Our experience, on the other hand, has shewn us that there are advantages in adopting this method, and the results which we have obtained with amalgamated zinc, have been very good.

The phenomena attending this process are interesting. It has been long known that in the electrolysis of a metallic salt, both the salt and the water of the solution are decomposed. In this case the sulphate of copper is at first resolved into sulphuric acid and oxide of copper, and the water also into its elements. The sulphuric acid being electro-negative goes over to the zincode, whither the oxygen of the decomposed water has also gone. Here the oxygen unites with the zinc to form the oxide of that metal, which is instantly dissolved by the free sulphuric acid, forming sulphate of zinc. But the hydrogen liberated from the decomposed water all goes to the platinode, where, finding the oxide of copper, it unites with its oxygen to form water, and the metallic copper is deposited, according to its own laws of crystallization, on the nearest metallic surface in the Voltaic circuits. Hence the art which forms the subject of this article. It must also be remembered that the same phenomena attend the zincode of this series that we have described as belonging to the copper or platinode, namely, water is there decomposed, the oxygen forms oxide of zinc, and the hydrogen goes to reduce the oxide of copper, unless indeed, there is an excess of sulphuric acid in the zinc cell, in which case, free hydrogen will be evolved from that cell. The deposit of metallic copper is an exact equivalent for the oxidation of the zinc. Indeed no deposit can take place until the zinc is oxidized, and hence the necessity of a free acid or saline fluid in the zinc cell, to commence the decomposition.

Much light has been thrown by these experiments and those of Mr. Fox on the mode in which metallic deposits occur in nature. But at this time we can only mention the subject; to treat of it would require more space than we can at present command; we postpone it therefore to some other occasion. B. S., Jr.

Yale College Laboratory, Dec. 23d, 1840.

Art. XX.—*Bibliographical Notices.*

1. *Report on the Tea Plant of Upper Assam; by* Wm. Griffith, *Assistant Surgeon Madras Establishment, late member of the Assam Deputation.** (From the Transactions of the Agricultural Society of Calcutta,) pp. 85, 8vo. With two plates and four maps or charts.—The important discovery that the genuine tea-plant is indigenous to Upper Assam, which was made in the year 1834, excited, as might be expected, a high degree of interest; and the East India Company, who were already attempting the cultivation of the tea in their possessions, by its introduction from China, appointed a deputation to examine the country in which the plant had been discovered. The officers selected for this duty were Dr. Wallich and Mr. Griffith as botanists, and Mr. McClelland as geologist, who set out upon their mission in the autumn of 1835. The pamphlet before us is said to be a second or revised report: we cannot determine the date of its publication, and we have not seen the volume of the Transactions of the Agricultural Society of Calcutta, of which it is said to form a part, but it probably appeared as early as the year 1838. Owing to the present relations of China with England, the subject of which it treats never possessed so great an importance as at the present time, unless indeed (as is not very improbable) the future experiments of the East India Company in the cultivation of the tea-plant are to be prosecuted on Chinese soil!

The report contains a good deal of merely local or personal matter, and is so extensive that we can give nothing like an analysis of its contents. The first part is occupied with the *Movements of the Deputation, enumeration of the tea localities, and the appearance of the Tea-plants.* The plant, it appears, occurs in patches of very limited extent, but the localities are said to be numerous. It is a shrub of ordinary size, or rarely reaching the altitude of a small tree, growing in low situations, in a very light and porous soil, which is always yellowish or reddish-yellow; and the climate is remarkable for its humidity. The second part consists of *Remarks on the Vegetation associated with the Tea-plant in Assam and in China.* The third is a *Comparison between the Flora of Upper Assam and that of China, in somewhat similar latitudes;* a subject of great difficulty, owing to the slight knowledge we possess of the vegetation of China, but which is very ably investigated by Mr. Griffith, especially as to the indications which the presence or predominance of particular tribes or

* Received from the author.

genera afford respecting the nature of the climate. Part IV is occupied with a *Comparison between the climate of Upper Assam and that of the Tea Provinces of Central China*, compiled from the imperfect observations that have been made. Part V, is an *Examination into the nature of the stations of the Tea-plant in the Province Kiang-nan and Kiang-see*, in which Mr. Griffith contradicts the opinion introduced by Abeel, and for a long time prevalent, that the plant is a native of, or at least better adapted to, places of considerable elevation, or of such a nature that snow and frost are of common occurrence in the winter months. In Part VI, *Remarks on the genus to which the Tea-plant belongs, and on the geographical distribution of the Indian plants of the same natural order*, the author comes to the conclusion that the tea-plant and the Camellia belong to the same genus. Part VII, which is occupied with *Remarks on the plans of Tea culture adopted by the Tea Committee, and on a proposed new and improved mode of cultivation;* it contains a brief history of the attempts which have been made to introduce and cultivate the tea-plant in India, and of the alleged mistakes which have been committed; it is very *controversial* in its character. The author also takes up the question whether the green and black teas of commerce are the produce of the same species, modified by culture, soil, and mode of preparation; or whether they are derived from two distinct species. But after enumerating the various opinions which have been advanced, he leaves this long controverted question exactly where he found it. The remainder of the report is chiefly devoted to a detailed consideration of the steps which should be followed in the cultivation of the plant, whether indigenous or imported, and which, in his opinion, would render its success certain. This conclusion is adopted on the following grounds, viz:—

1. That the tea-plant is indigenous to, and distributed extensively over, large portions of Upper Assam.

2. That there is a similarity in configuration between the valley of Assam and two of the best known tea provinces of China.

3. That there is a similarity between the climates of the two countries, both with regard to temperature and humidity.

4. That there is a precise similarity between the stations of the tea-plant in Upper Assam, and its stations in those parts of the provinces of Kiang-nan and Kiang-see that have been traversed by Europeans.

5. That there is a similarity both in the associated and the general vegetation of both Assam and those parts of Chinese tea provinces situated in or about the same latitude.

2. *Report of* M. Guillemin, *Botanical Assistant at the Museum of Natural History, presented to the Minister of Agriculture and Commerce, on the subject of the Expedition to Brazil, undertaken principally with the view to obtain information respecting the culture and preparation of the Tea-plant, and the introduction of this shrub into France.* (Revue Agricole, 16me livraison.)—An abridged translation of this report is published in the seventeenth number of Hooker's Journal of Botany, for October, 1840. Mr. Guillemin returned from his important expedition in July, 1839, bringing with him fifteen hundred living tea-plants, about one third of the number with which he left Rio Janeiro, and having collected much information respecting the cultivation and preparation of tea in Brazil. The following extract is copied from the translation mentioned above.

"In the middle of November I had an opportunity of observing the method pursued when culling the tea, which is performed by black slaves, chiefly women and children. They carefully selected the tenderest and pale green leaves, nipping off with their nails the young leaf bud, just below where the first or second leaf was unfolded. One whole field had already undergone this operation; nothing but tea shrubs stripped of their foliage remained. The inspector assured me that the plant receives no injury from this process, and that the harvest of leaves was to become permanent by carefully regulating it, so that the foliage should have grown again on the first stripped shrubs, at the period when the leaves of the last plants were pulled off. About twelve thousand tea shrubs are grown in this garden; they are regularly planted in quincunxes, and stand about one metre distant from each other; the greater number are stunted and shabby looking, probably owing to the aspect of the ground, which lies low, on the level of the sea, and exposed to the full rays of a burning sun; perhaps the quality of the soil may have something to do with it, though this is apparently similar to the prevailing soil in the province of Rio Janéiro. This soil, which is highly argillaceous, and strongly tinged with tritoxide of iron, is formed by the decomposition of gneiss or granite rocks. The flat situation of this tea ground is unfavorable to the improvement of the soil, for the heavy rains which wash away the superfluous sand from slanting situations, of course only consolidate more strongly the remaining component parts, where the land lies perfectly level, and thus the tea plants suffer from this state of soil.

"The kindness of M. de Brandao, Director of the botanic garden, induced him to invite me, shortly after I had seen this above described tea ground, that I might inspect all the operations for the preparation of tea. I found that the picking of the leaves had been commenced very early in the morning, and two kilogrammes were pulled that were still wet with dew. These were deposited in a well polished iron vase, the shape being that of a very broad flat pan, and set on a brick furnace, where a brisk wooden fire kept the temperature nearly up to that of boiling water. A negro, after carefully washing his hands, kept continually stirring the tea leaves in all directions, till their external dampness was quite evaporated, and the leaves acquired the softness of linen rag, and a small pinch of them, when rolled in the hollow of the hand, became a little ball that would not unroll. In this state the mass of tea was divided into two portions, and a negro took each and set them on a hurdle formed of strips of bamboo, laid at right angles, where they shook and kneaded the leaves in all directions for a quarter of an hour, an operation on which much of the beauty of the product depends, and which requires habit in order to be properly performed. It is impossible to describe this process: the motion of the hands is rapid and very irregular, and the degree of pressure requisite varies according to circumstances; generally speaking, the young negro women are considered more clever at this part of the work than older persons. As this process of rolling and twisting the leaves goes on, their green juice is drained off through the hurdle, and it is essential that the tea be perfectly divested of the moisture, which is acrid, and even corrosive, the bruising and kneading being specially designed to break the parenchyme of the leaf, and permit the escape of the sap.

"When the leaves have been thus twisted and rolled, they are replaced in the great iron pan, and the temperature raised till the hand can no longer bear the heat at the bottom. For upwards of an hour the negroes are then constantly employed in separating, shaking, and throwing the foliage up and down, in order to facilitate the desiccation, and much neatness and quickness of hand were requisite, that the manipulators might neither burn themselves nor allow the masses of leaves to adhere to the hot bottom of the pan. It is easy to see that, if the pan were placed within another pan filled with boiling water, and the leaves were stirred with an iron spatula, much trouble might be obviated. Still, the rolling and drying of the leaves were successfully performed; they became more and more crisp, and preserved their twisted shape, except some few which seemed too old and coriaceous to submit to be rolled up. The tea was then placed on a sieve, with wide apertures of regular sizes, and formed of flat strips of bamboo. The best rolled leaves, produced by the tips of the buds and the tenderest leaves, passed through this sieve, and were subsequently fanned, in order to separate any unrolled fragments which might have passed through with them; this produce was called *Imperial*, or *Uchim Tea*. It was again laid in the pan, till it acquired the leaden gray tint, which proved its perfect dryness, and any defective leaf which had escaped the winnowing and sifting was picked out by hand. The residue, which was left from the first fanning, was submitted to all the operations of winnowing, sifting, and scorching, and it then afforded the *Fine Hyson Tea* of commerce; while the same operations performed on the residuum of it, yielded the *Common Hyson;* and the refuse of the third quality again, afforded the *Coarse Hyson.* Finally, the broken and unrolled foliage, which was rejected in the last siftings, furnish what is called *Family Tea*, the better kind of which is called *Chato*, and the inferior *Chuto.* The latter sort is never sold, but kept for consumption in the families of the growers.

"Such is the mode of preparation pursued at Rio Janeiro, though I must add, that the process employed at the botanic garden being most carefully performed, in order to serve as a model for private cultivators of tea, the produce is superior to the generality, so that we dare not judge of all Brazilian tea by what is raised at the garden of Rio."

Mr. Guillemin recommends the western extremity of the department of Finisterre, as having a soil and climate more suitable to the culture of tea, than any other part of France.

"And now to come to the important question, whether the growth and preparation of tea can furnish an advantageous branch of agriculture in France,—the decision rests on so many contingencies, of the quantity of respective produce from a given portion of soil, and the price to be realized by the article when produced, that it is very difficult to arrive at a satisfactory and correct answer. In Brazil, where, as I have stated above, the culture of the shrub succeeds perfectly well; where the gathering of the foliage proceeds with hardly any interruption during the entire year; where the quality (setting aside the aroma which is believed to be artificially added) is not inferior to that of the finest tea from China, still the growers have not realized any large profits. They have assuredly manufactured an immense quantity of tea, to judge by what I saw in the warehouses at St. Paul, but they cannot afford to sell it under six francs for the half kilogramme, a lb. weight, which is higher than Chinese tea of equally good quality. Indeed, the trade of tea is still in great activity between China and Brazil, partly by ships which come straight from the former country to Rio Janeiro, and partly through the United States. Could we insure France a similar modicum of success in rearing the plants, as in Brazil, it may be fairly calculated that considerable improvements would take place; the lower price of labor would diminish the cost of its produce; more economical and expeditious plans for preparing the leaf might easily be invented; and finally, if we could succeed in imparting the perfume which distinguishes the Chinese tea, there can exist little doubt that our home-grown article might compete advantageously with the foreign one, especially in the event of a war with China, or other interruption of our maritime intercourse with the East. Whatever be the tenor of future public affairs, the cultivation of the tea-plant should, under every circumstance, be carefully essayed in France; a fair trial should be given to it, and as it could not be prejudicial to other agricultural interests, requiring such a locality as is little adapted to other productions, I am the more disposed to think that it merits the encouragement and favor of government."

Mr. Guillemin's attention was also directed to the cultivation of coffee in Brazil, but no details are given.

3. *The Spiritual Life of Plants.*—We extract the following from Meyen's *Report on the Progress of Vegetable Philosophy, for the year* 1837, (published late in 1838,) as translated by Mr. Francis. It affords a good idea of that tendency to transcendentalism which thoroughly pervades the German mind, and has found its way into physical as well as psychological science.

"M. v. Martius* has published his views on the soul of plants, with which I may commence the present year's report. It appears, observes M. v. Martius, as if natural philosophers were in general not inclined to admit, in the essence of the plant, these two spheres, body and soul, as if they would concede a soul only to animals and man. It is usual to regard as the essential predicate of the soul, perception such as it appears in animal life; and, as in the vegetable kingdom, we are acquainted with very few phenomena which admit of our concluding upon a power of perception in plants, they have been declared not to possess a soul. Von Martius points out, that even animal forms sink so low in the scale of organization, that all the characteristics of animal life disappear in them; on the other hand, indications of vegetable life display themselves; whilst in the more highly developed vegetable forms, phenomena occur which belong to animal life, such, for instance, as the manifold various motions which have been observed in plants: in fact, that animal life and vegetable life appear in no way to be so decidedly separated from each other, and for that reason, therefore, a soul cannot be admitted in animals alone, and denied to vegetables. Even the predominant growth and the propagation of plants appear to indicate that they are not confined to the circle of rigid necessity; and we must recognize in them a kind of predetermination, a tendency to the ideal, consequently a higher vital princi-

* Reden und Beiträge über Gegenstände aus dem Gebiete der Naturforschung, Stuttgard und Tübingen, 1838.

ple, a soul. The soul of plants is much less complex than that of animals; it is, in fact, in itself, of a more obscure and undefined nature. Perception, imagination, consciousness, sensation, desire, volition, appear here to have sunk into the night of a gloomy, confined existence, and the narrow path of analogy and induction towards this subject, unattainable by our inquiries, is open to us but for a short distance. The vegetable soul must not, however, be compared with the soul of man, or with that of the higher animals, but rather with the nucleus, or that point of the axis only, around which the life of the lowest and most simple animals revolves. Von Martius thinks that we can admit of no organ of soul in plants; yet we may probably succeed, as I think, in our time, in discovering this organ even in plants; the nervous system has, as is well known, been already observed in vegetables, by some learned botanists, although others, it is true, have not been able to convince themselves of the fact.

"A series of phenomena are moreover enumerated, such as the specific susceptibility of plants for the actions of light, heat, air, moisture, &c., which, without a certain degree of sympathy and of perception, without a kind of internal consciousness, could not possibly have effect. Perhaps in them all the various grades of spiritual action combine to produce one single obscure idea. The more general and intense the irritation which acts upon plants, the more powerful is the perception. The sleeping and waking of plants, as also their hybernation, correspond exactly to the similar phenomena in animals, only that these states in plants are involuntary. The soul of the plant is diffused throughout it; in so far, however, as the vegetable soul acts according to its nature, formatively, plastically, one might say that it is situated in the more highly organized plants, principally in the node, in which the vegetable powers slumber.

"This latter opinion might however be disputed, as might generally the entire current doctrine of the composition of plants of internodes, on which subject we shall subsequently have occasion to speak more in detail. With respect to the rest I agree perfectly with M. von Martius; nay, it is to me inconceivable how all those phenomena of the *vita sensitiva* of plants can be thought to be explained by the indefinite expression of irritability.

"Von Martius next enumerates the other manifold processes which the vegetable soul has to superintend when the plant is propagating by sexual intercourse, and concludes these observations with the following words: 'Among intricate perceptions and ideas, a dark sensibility and consciousness, a sympathy, a stimulus, an increase of this to affection, probably also a kind of memory in the repetition of certain physical actions; all this we may deduce from the various habits of plants, if we compare them with analogous relations in animal life. We are not, however, able to trace in them a higher sense, understanding, or free will.'

"With the preceding is immediately connected a memoir by M. v. Martius,* which treats of the immortality of plants. The idea of the immortality of plants is the next step to the proof of the existence of a vegetable soul; but M. v. Martius himself observes, in the introduction, that it is true that many scientific men, *to whom the power of comprehending the transcendental has been imparted in a lower degree*, will regard the consideration of such a subject as a digression; he however believes that the greater part of mankind are so organized, that they will adopt conclusions, and acquiesce in consequences, which rise above the world of sensible contemplations and perceptions into the higher world of the spirit. The conviction of the immortality of plants can however in no case be deduced from any proof derived from the nature of plants, but it must be peculiarly the *conception of the individual mind.*

"In the corporeal life of the plant there exist intention, tendency, and means for their attainment; nay, we even see this controlled by the fitness of time, in the same way as in more highly endowed man. The plant, like the animal, has inward intentions to fufil outwardly, fulfils them like the latter, and indeed in the same way, more or less perfectly, according to the various conditions of which they consist. There is therefore only a difference of degree between the unknown unity which predominates over all this activity, and which in man is termed his soul, and the spontaneous power analogous to this soul, which the plant exhibits in action during its whole life. We do therefore an injustice to the plant when we consider it as not being, like the animal, endowed with a common primary force, penetrating through all parts, and directing them all to certain actions. From these views, however, it would result, that all inorganic bodies are also endowed with a soul, a thought which has been already asserted in the most ancient times; nay, Von Martius arrives at the conclusion, that every thing earthly, and therefore also the plant, possesses a soul, and the numberless fraternity of similar creatures, which act so prominent a part in the universal life of our planet, are, according to their scale, governed by a soft, peaceful spirit, an *Anima blandula trepidula.*"

4. *The Journal of Botany*, &c.; by Sir Wm. J. Hooker, LL. D., &c.—We some time since noticed the resumption of this periodical Journal, and gave a list of the contents of the first two numbers, viz.

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* *L. c.* p. 261—286.

Nos. 9 and 10 of the second volume, the publication of which was suspended in the year 1835. The *Companion to the Botanical Magazine* took its place for two years, but this, the cheapest botanical periodical ever published in Great Britain, was then discontinued, (for the want of adequate support,) or rather was merged in the *Annals of Natural History*, and there was no longer an exclusively botanical periodical in the English language. The *Botanical Magazine* and the *Botanical Register* cannot be considered to form exceptions to this statement, for they are occupied with figures and descriptions of plants interesting to the floriculturist, and newly introduced into the gardens or conservatories of Great Britain. About this time, however, Dr. Lindley changed the plan of the *Botanical Register*, a portion of which is now devoted to botanical information, notices of new works, &c., which the talents and opportunities of its learned editor render very interesting. The Journal of Botany takes a wider range, consisting of extended botanical notices, letters from botanists who are making collections in different parts of the world, occasional memoirs and portraits of deceased botanists, descriptions and figures of interesting plants, (of the latter there are two in each number,) and original articles from the pen of the indefatigable editor, and from other botanists, particularly Mr. Bentham and Dr. Arnott. It is published regularly on the first of each month, and the number for October (the seventeenth) commences the third volume of the series. We trust that the work will receive the support it so richly merits, and which will ensure its continuation.

5. *Hooker's Flora Boreali-Americana, or the Botany of the Northern parts of British America*, 2 vols. 4to. 1829–40.—The twelfth part, which contains the remainder of the grasses, the ferns, and the small orders allied to the latter, brings this important work to a conclusion within the limits originally prescribed. The botanists of this country especially will regret that the work was not extended so as to include the mosses and the Hepaticeæ, the field of the distinguished author's early fame. This fasciculus contains twenty plates, (making the whole number 238,) among which are the following species of *Carex*, viz. *C. aperta*, *C. Hoppneri*, *C. Sitchensis*, *C. recta*, *C. Richardsonii*, *C. podocarpa*, *C. eburnea*, (C. alba *var.* setifolia, *Dewey*,) and *C. amplifolia*, the greater portion of which are new species described by Dr. Boott. The remaining plates represent grasses, one fern, and a species of Lycopodium, all natives of high northern and western regions. The lovers of natural science in this country are under the highest obligations to Sir Wm. Hooker, for his unwearied labors upon North American botany.

6. *Endlicher's Genera Plantarum.*—Since our notice of this invaluable work in the number of this Journal for July last, we have received the 12th, 13th, 14th and 15th numbers. The latter, published in June last, reaches to the 1200th page. It contains a part of his class *Calycifloræ*, and breaks off in the middle of his 267th order, *Lythrarieæ.* Two, or perhaps three, additional numbers, will apparently bring the work to a conclusion, as the Rosaceæ and the Leguminosæ are the chief remaining orders.

7. *Enumeratio Chenopodearum.*—Mr. Moquin-Tandon, of Toulouse, who has long made the Chenopodiaceæ and the related families his peculiar study, has published a complete monograph of the order. We have not yet seen the work, but are informed that it is a small octavo volume, published at Paris.

8. *Stendel's Nomenclator Botanicus.*—A new edition of this well known work, which has been so long a desideratum, is now in the course of publication at Leipsic. If we are rightly informed it will follow the classification of De Candolle, and that a complete index of genera, species, and synonyms, for all the orders yet published in the Prodromus, will very shortly be in the hands of botanists.

9. *Caricography.*—Prof. Kunze, of Leipsic, has commenced to publish, in occasional numbers, a continuation of Schkuhr's Caricography, in which he intends to give figures of all the species which are not represented in that well known work. It is said, also, that Prof. Kunze will publish a continuation of Schkuhr's similar work on the ferns.

10. *Fossil Infusoria in England.*—The Journal of Botany, for June, 1840, contains a paper "*On a white fossil powder found under a bog in Lincolnshire, composed of the silicious fragments of microscopical parasitical Confervæ; by* J. E. Bowman, Esq., F. L. S."—He gives a history of their discovery by Prof. Ehrenberg, and a notice of the article of Prof. Bailey, (who first detected them in this country,)* which "stimulated scientific men to examine similar depositions wherever they might occur, for as yet it was not suspected that any thing of a like nature existed in Great Britain." Dr. Drummond, of Belfast, announced their discovery in Ireland, in the Magazine of Natural History for July, 1839, in the form of an earthy powder, brownish when wet, but of the whiteness of chalk when dry, and as

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* See Vol. xxxv, p. 118, of this Journal.

light as carbonate of magnesia, which it much resembles; on lowering the waters of a small lake this was found under the covering of a boggy soil, and in other similar situations. The substance was proved to consist almost wholly of the silicious skeletons of *infusorial vegetables*, if they may be so called, or of those equivocal beings which occupy the borders of the two kingdoms, and render it difficult, not to say impossible, to draw the line between them. Their discovery in England is due to Mr. Binney of Manchester, and we extract the following from Mr. Bowman's account.

"He [Mr. Binney] informs me that so long ago as 1836, being then on a visit in Lincolnshire, he observed a whitish pulverulent substance on the sides of a deep ditch, which he at first took to be lime, but on examination, finding it to be quite different in its properties from that body, he supposed it to be of animal origin. The place where it was found is a portion of a reclaimed peat bog, about four feet in thickness, lying on the upper red marls, one mile east of the escarpment of Lias limestone, in the valley of the Trent, in Blyton Car, near Gainsborough. The peat was in a high state of decomposition, and had been under cultivation for some years. The white substance in question had been thrown out in widening the ditch, and originally occupied a bed varying in thickness from four to six inches, at the depth of about a foot under the surface of the peat, and extending over an area of several acres of land. In some places the powder was mixed with portions of peat; but in others it was quite free from such admixture. When first dug up, it was of a yellowish color, and in a state of paste; but on becoming dry it changed to a beautiful white powder, that floated in the atmosphere on the slightest agitation, was tasteless, and bore a great resemblance to calcined carbonate of magnesia. Conceiving that it might be fatty matter in a state of adipocire, he successively treated it with sulphuric, hydrochloric, and nitric acids, and afterwards submitted it to the action of heat, by all which processes it remained unchanged; and he was thence led to believe it was silica in an extremely minute state of subdivision. He had subsequently subjected it, under the action of the blowpipe, to an intense white heat for fifteen minutes, and he had treated it with the carbonates of potash and of soda, and thus formed silicates of these substances. He afterwards learned that a similar substance was found in considerable abundance near Haxey, in the peat deposit of the neighboring level of Hatfield Chase, and was informed by the farmers there that wherever it occurred, the soil above it was very poor and unproductive. This fact is a strong confirmation of its being silica, such soils being proverbially sterile. In this stage of his knowledge, Mr. Binney saw Dr. Drummond's account of the powder from Lough Island Reary, to which I have referred, and immediately recognized the deposit of Blyton Car to be analogous. Indeed, it is remarkable how closely the two descriptions coincide; and it will be observed, that in both these cases, as well as in that from the United States, the powder was found *under peat*, and resisted the action of acids and of heat. He shortly afterwards procured a fresh supply from Lincolnshire, and submitted it to several friends; among others he requested me to examine it closely, and communicate the result. The little acquaintance I had with the obscure, neglected, but pre-eminently beautiful and extraordinary tribe of the *Confervæ*, showed me, on the first inspection of the powder, the high probability of its connexion with them; and a reference to some specimens in my own herbarium, and to magnified figures of others in the works of Greville, Sowerby, &c., soon convinced me that it was indeed the accumulated remains of myriads of these minute aquatic plants, purified by the decomposition of all their original vegetable matter, and effectually secured from contact with other impurities, by the superincumbent peat."

The article is concluded by an interesting account of the character and habits of the minute Confervæ. The specimens described and figured by Mr. Bowman, are species of *Diatoma*, or allied genera.—It has been somewhere remarked, or conjectured, that these deposits are perhaps confined to the region of primitive rocks, although it is not easy to conceive any relation or connexion between these bodies and the nature of the soil or rock where they are accumulated; and the manner of their occurrence in this case, and indeed on the European continent generally, contradicts that supposition.*

11. *Chemical composition of cellular and woody tissue in plants.*—That most accomplished vegetable anatomist, Mohl, of Tubingen, has the merit of having satisfactorily ascertained that what is called woody tissue is not simple and homogeneous, but consists of elementary membrane, or cells, and a thickening or encrusting matter that possesses different properties. The subject has recently been taken up in France by M. Payen, whose memoir, said to be a beautiful specimen of chemico-physiological investigation, was read before the Academy of Sciences in December, 1838, and January, 1839. An abstract of this memoir, and the report of M. Dumas on the subject, are published in the *Annales des Sciences Naturelles*, for January,

* This silicious deposit has been found under nearly every peat bog in this country which has yet been examined. Numerous specimens from various parts of this State (Conn.) have been brought to us. When it is calcined and washed it forms a very good polishing powder for metals; and is now, under various feigned names, extensively used for this purpose.—Eds.

1839. The principal results which M. Payen has established very satisfactorily are, that the organic membrane and the matter deposited upon it, or the *lignine*, properly so called, have a different composition, and are differently affected by chemical agents. The latter is attacked by alkalies and by strong acids, the former resists their action. The former exactly accords with starch in chemical composition, the carbon being 44 per cent., and the oxygen and hydrogen in the proportions to constitute water; the latter consists of 54 carbon, 6.2 of hydrogen, and 39.8 of oxygen, containing therefore more hydrogen than is required to convert its oxygen into water. "This phenomenon accords perfectly with the recent experiments of Colin and Edwards, which have demonstrated that plants possess the power of decomposing water; and with those of Boussingault, which have proved that a quantity of hydrogen is fixed in the plant during vegetation." The researches of Payen in this department of science, are noticed in *Meyen's Report on the Progress of Physiological Botany*, for 1839, a translation of which is commenced in the October number of the Annals of Natural History. Prof. Meyen seems to think the general results may be relied upon, but points out some sources of error.

12. *Organic Chemistry in its applications to Agriculture and Physiology;* by Justus Liebig, M. D., Ph. D., F. R. S., M. R. I. A., Professor of Chemistry in the University of Geissen, &c.; edited from the manuscript of the author, by Lyon Playfair, Ph. D. London, 1840, Taylor & Walton.* During the last twenty years, no science has had more ardent devotees, or more industriously accumulated facts, than organic chemistry; and the name of the author of this treatise stands pre-eminent among its European cultivators. Expectation has long been awakened, in the hope that some generalizations and practical truths would be drawn from the vast mass of facts in this science, applicable to the wants of the times, and to the advancement of our knowledge of agriculture. Whenever this time should arrive, it was confidently believed that the profession of agriculture would receive great and permanent advancement. It is not too much to say, that the publication of Prof. Liebig's Organic Chemistry of Agriculture, constitutes an era of great importance in the history of agricultural science. Its acceptance as a standard is unavoidable, for following closely in the straight path of inductive philosophy, the conclusions which are drawn from its data are incontrovertible. Confined to the limits of a short notice, we cannot more than glance at the new views of the author on subjects of the highest importance to the agri-

* This work is about to be republished in this country, by Messrs. Wiley & Putnam, New York and London, under the charge of the junior Editor of this Journal.

culturist and physiologist. Since the time of Sir Humphry Davy no champion of agricultural chemistry has before appeared, and this science, without which no rational system of agriculture can be hoped for, has been apparently neglected.

Great stress has been laid, by chemists and vegetable physiologists, on that constituent of soils which they have variously designated as humus, humin, coal of humus, humic acid, ulmin, extractive matter, geine, soluble and insoluble, and apotheme. The modifications of humus, which are soluble in alkalies, have been called *humic acid*, while those which are insoluble have been described as humin, and coal of humus. Berzelius, in 1833, published, in the memoirs of the Stockholm Academy,* an account of two new acids, the crenic and the apocrenic, found in the waters of Porla well, in Sweden, and which he had previously (1807)† designated in his examination of those waters, under the appellation of extractive matter; and it will be seen by our notice of Dr. Jackson's geological survey of Rhode Island, in this number, that he has proved extensively the existence of these two acids in the soils of that State, as well as in certain natural waters. It is this substance, we repeat, by whatever name it is called, to which so much importance has been attached by writers on vegetable physiology, and by agricultural chemists, as probably constituting an important part of the food of plants.

"The opinion that this substance is extracted from the soil by the roots of plants, and that the carbon entering into its composition, serves in some form or other to nourish their tissues, is so general, and so firmly established, that hitherto any new argument in its favor has been considered as superfluous; the obvious difference in the growth of plants, according to the known abundance or scarcity of *humus* in the soil, seemed to afford incontestable proof of its correctness. Yet this position, when submitted to a strict examination, is found to be untenable, and it becomes evident, from the most conclusive proofs, that *humus*, in the form in which it exists in the soil, does not yield the smallest nourishment to plants."

"The names given to these substances might lead to the supposition that their composition is identical. But a more erroneous notion could not be entertained. Thus, humic acid, obtained by the action of hydrate of potash on saw-dust, contains, according to the accurate analysis of Peligot, 72 per cent. of carbon, while that from turf and brown coal contains, according to Sprengel, only 58 per cent.; that produced by the action of dilute sulphuric acid on sugar, 57 per cent.; and that lastly which is obtained from sugar or from starch, by means

* Kong. Vet. Acad. Had. 1833, p. 18. Poggendorff's Annalen, xxix. 1, and 238. Also, Thomson's Chemistry of Organic Vegetable Bodies, pp. 146, 1838.

† Afhandlingar, p. 145.

of muriatic acid, according to the analysis of Stein, 64 per cent. It is quite evident, therefore, that chemists have been in the habit of designating all products of the decomposition of organic bodies, which had a brown or brownish black color, by the names of humic acid or humin, according as they were soluble or insoluble in alkalies; although in their composition and mode of origin, the substances thus confounded might be in no way allied. Not the slightest ground exists for the belief that one or other of these artificial products of the decomposition of vegetable matter exists in nature, endowed with the properties of the vegetable constituents of mould; there is not a shadow of proof that one of them exerts any influence on the growth of plants, either in the way of nourishment or otherwise."

This position is maintained at length, by a series of close arguments and calculations, made with the object of ascertaining the quantity of carbon contained in a given quantity of fir, pine and birch wood, of grain, of beet roots, and of hay, growing upon forty thousand square feet (Hessian) of land,* either forest, arable, or meadow, according to the produce. These estimates are made with great care, from the best analyses, and show that forty thousand square feet of wood and meadow land produce annually 1007 lbs.† carbon, while the same extent of arable land yields in beet roots, without leaves, 936 lbs., or in corn 1020 lbs.—from which it appears that equal surfaces of cultivated land, of average fertility, produce equal quantities of carbon. Now supposing this carbon to be supplied from humic acid, dissolved in the form of humate of lime, (the most soluble of its salts,) and conveyed into the plants by means of rain water; under the most favorable circumstances which can be supposed to exist, even allowing that potash, soda, and the oxides of iron and manganese, have the same capacity of saturation as lime, by humic acid, the quantity of wood on the above named surface of land sufficient to account for the absorption of humic acid supposed to take place, would be 91 lbs. only, while it is proved that the same superficies actually produces annually 2650 lbs. of fir wood. Whence, then, do plants obtain their carbon? Undoubtedly from the atmosphere, by decomposing the carbonic acid which is its constant constituent. Prof. Liebig shows that the aggregate weight of carbon in the atmosphere exceeds 3000 billion lbs. Hessian, equal in the form of carbonic acid to $\frac{1}{1000}$ of the volume of the atmosphere. The value of humus in the soil (and it must be remembered that as humus is entirely due to organic life, no humus could have existed previous to the existence of vegetables) con-

* One Hessian acre, equal to 26,917 English square feet.

† One pound Hessian is equal to about eleven tenths English, and consequently 1000 lbs. equal 1102 lbs. English.

sists merely in its furnishing a slow and lasting source of carbonic acid, during its decomposition, which is absorbed by their roots, and constitutes the principal aliment of young plants, at a time when, being destitute of leaves, they are unable to extract food from the atmosphere.

The existence of ammonia as a constant constituent of the atmosphere, had never been proved, or even suspected, before the researches of Prof. Liebig, and the great importance of the discovery, in a practical point of view, can be justly appreciated only by a careful perusal of the present treatise. In what manner ammonia is produced in quantity sufficient to be the chief, indeed the only means of conveying to plants all the nitrogen they contain, is fully elucidated. It is shown that rain water and snow always contain ammonia, and it may be proved to the satisfaction of any person, by adding a little sulphuric or muriatic acid to rain water, and evaporating it in a clean porcelain capsule nearly to dryness, when the ammonia may be detected by adding to the residuum a little powdered lime, which will liberate the ammonia. Thus produced, it always has an offensive animal odor, fully indicating its origin. It is a most interesting thing, that in the discovery of ammonia in the atmosphere we have also discovered the true cause of the great fertilizing effects of *gypsum*, or *plaster of Paris*, a key to which has been so long sought in vain.

This fertility arises exclusively from the fact that the sulphate of lime fixes in the soil the ammonia dissolved in the atmosphere, which would otherwise be volatilized with the water as it evaporates. The carbonate of ammonia contained in rain water is decomposed by gypsum, in precisely the same manner as in the manufacture of sal ammoniac. Soluble sulphate of ammonia and carbonate of lime are formed, and this salt of ammonia possessing no volatility, is consequently retained in the soil. The action of gypsum, or chloride of calcium, (muriate of lime,) really consists in giving a fixed condition to the nitrogen or ammonia which is brought into the soil, and which is indispensable to the nutrition of plants. The decomposition of gypsum by carbonate of ammonia, does not take place, however, instantaneously; on the contrary, it proceeds very gradually, and this explains why the action of gypsum lasts for several years. The reason why the fact that ammonia is always present in the atmosphere has heretofore escaped observation, is, that the quantity in any portion of atmospheric air which is usually employed for analysis, is so exceedingly small that it might most naturally be overlooked, or classed among the errors of observation. But the detection of ammonia must be much more easy when a pound of rain water is examined, which contains all the gas diffused through 20,800 cubic feet of air. If a pound of rain water contains only $\frac{1}{4}$ grain of ammonia, then a field of 40,000 square feet (one Hessian acre, or 26,917 English square feet) receives annually upwards of 80 lbs. of ammonia, or 65 lbs. of nitrogen. This is much more nitrogen than is contained in the form of vegetable albumen in 2650 lbs. of wood, or 2800 lbs. of hay, which are the annual products of such a field ; but it is less than the straw, roots and grain of corn, which might grow on the same surface, would contain. As nitrogen is always present in considerable quantity, in some part or other of plants, the importance of food containing it can scarcely be overrated, especially as, according to the view of Prof. Liebig, the assimilation of substances generated in the leaves will (cæteris paribus) depend on the quantity of nitrogen contained in the food. The great efficacy of animal manures is shown to depend mainly on the nitrogen and carbonic acid which they furnish.

But we must hasten to close this very imperfect notice, passing almost in silence the author's remarks on the mineral constitution of soil, and on culture and rotation of crops, which are as important and original as the foregoing parts. Speaking of the composition of soils, he cites the neighborhood of Vesuvius as the type of a fertile soil, and as it is formed entirely from the disintegration of lava, it cannot possibly, on account of its origin, contain the smallest trace of vegetable matter ; yet it is well known that when volcanic ashes have been exposed for some time to the influence of air and moisture, a soil is gradually formed in which all kinds of plants grow with the greatest luxuriance. This fertility is owing to the alkalies contained in the lava, and which, by exposure to the weather, are rendered capable of being absorbed by plants. It is the greatest possible mistake to suppose that the temporary diminution of fertility in a soil is owing to the loss of humus; it is the mere consequence of the exhaustion of the alkalies. The fallow time is that period of culture during which land is exposed to a progressive disintegration, by means of the influence of the atmosphere, for the purpose of rendering a certain quantity of alkalies capable of being appropriated by plants. Now it is evident that the careful tilling of fallow land must increase and accelerate this disintegration. For the purpose of agriculture it is quite indifferent whether the land is covered with weeds, or with a plant which does not abstract the potash enclosed in it. Hence the secret of the success of that greatest of all improvements in modern agriculture, the rotation of crops ; especially if we consider, in connexion with it, the fact that many plants excrete from their roots those matters not fit for assimilation to form their organs, and the accumulation of which soon renders the soil unfit to support a succession of the same plants, although the matter thus rejected may be salutary, or at least innoxious to plants of other orders. There follow most important chapters on manure, the composition of animal manure, the essential elements of manure, bone manure, the supply of nitrogen by animal manures, mode of applying urine, value of human excrements, which, with some concluding remarks, finish the first part of this unique volume. We must here conclude our remarks, without attempting the least analysis of the second part, which is devoted to a discussion on the chemical processes of fermentation, decay, and putrefaction.

To some, the style of this work may seem somewhat obscure; but it will be found, on a re-perusal, that great condensation, brevity and terseness have been mistaken for obscurity. It presupposes a good degree of chemical knowledge on the part of the reader, and for that reason needs elucidation by notes, for the advantage of those who do not possess that knowledge. But we can truly say, that we have never risen from the perusal of a book with a more thorough conviction of the profound knowledge, extensive reading, and practical research of its author, and of the invincible power and importance of its reasonings and conclusions, than we have gained from the present volume.

13. *Report on the Geological and Agricultural Survey of the State of Rhode Island, in* 1839; by Dr. Charles T. Jackson, Mem. Geol. Soc. of France, &c. Providence, 1840. B. Cranston & Co.

1. *Some notice of the Geological portion of Dr. Jackson's Report.*

The labors of Dr. Jackson in other years have been favorably noticed in our reviews of his reports on the geology of Maine and Massachusetts in previous volumes of this Journal. The territory which is the subject of the present memoir, is the smallest but one, of the twenty six states of our federal union, and we cannot therefore expect to find in it all that variety which characterized the reports of the same author previously alluded to. This report is naturally divided into two parts, the geological and the agricultural. We will begin with the consideration of the former.

It is introduced by a sketch of scientific geology, which, with official correspondence, occupies 45 pages; the general and local geology of the State fills 140 pages; the account of the analysis of soils and manures, 64; the farm reports, 40: there are fourteen wood cuts in the text, seven in distinct pages, a folded geological map of the State, colored for the formations, and a second folded sheet containing four colored cross sections; besides ample tables, exhibiting in a condensed form the results of the analyses of soils.*

* The typography is good, and the paper white, but far too thin,—a common fault with American books, especially as the paper is made chiefly of cotton.

This able report exhibits, as we might expect from the high character of its author, abundant proof of laborious, careful and skillful investigation, and, both in its scientific and practical bearings, forms altogether a valuable document. In determining the geological age of rocks, Dr. Jackson gives a preference to "superposition of strata and the mineralogical composition" over "zoological and botanical characteristics," which however he allows to be "of great value." He prefers also the Wernerian division of transition rocks to the "names Cambrian and Silurian, proposed for certain groups in England," which he thinks "will never be regarded in this country as appropriate terms for our rocks."

While we agree with Dr. Jackson that a successful substitute for the transition division has never yet been made, we are inclined to think that Mr. Conrad, Mr. Vanuxem, and their associates, have so far identified our great western fossiliferous formations with the Silurian and Cambrian of Mr. Murchison, that his names will be found to be convenient appellatives for vast regions of our country, subordinate to the more extensive class of transition.*

Dr. Jackson has justly magnified the importance of the fusion of chalk under immense pressure, by Sir James Hall, and its conversion into crystallized limestone without the loss of its carbonic acid, and he has found in the intrusive greenstone and other trap dykes among the sandstone strata of Maine and Nova Scotia, the same results that volcanic injections are known to produce, namely, vesicular scoriæ, increased hardness, and moreover in particular places the separation of metallic copper, evidently by fusion and reduction from its ores.

We wish we could feel satisfied with the author's ingenious suggestion that "gneiss is the mere crust of rapidly cooling granite." How can this be reconciled with the immense thickness as well as extent of its strata in the mountains of New England and in other parts of the world, and with the extremely limited and slow conduction of heat through masses of rock? The cooling, it is true, would begin on the surface, and would travel inward, through no matter how long an extent of time; but how would the laminar arrangements arise, thousands of feet from the surface, any more than in the subjacent granite nucleus or substratum? Granites, it appears, differ very much from each other in fusibility, and minerals still more infusible are produced by segregation both in granites and lavas.

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* Our author, however, justly remarks, "that new classifications may be proposed by the scientific men now engaged in collecting facts, but that none of those local appellations so frequently put forth by geological writers ought to be universally adopted, until opportunities for a general discussion take place, which will ere long be effected by the union of the transatlantic geological societies and those of this country."

Dr. Jackson has furnished a lucid account of the minerals that are essential to the constitution of rocks. He remarks that silex, the most abundant substance in the globe, enters into the composition of all plants, and Prof. Liebig, in his recent work on the *Chemistry of Agriculture*, has shown that the silex is always taken up by plants in the form of silicate of potash; for, the decomposition of the primary rocks to form the basis of our soils, furnishes both materials in abundance. Silex is also, in vast quantities, the petrifying material of myriads of animalcules* beneath peat bogs and in marshes and swamps.

The fixed alkalies, potash and soda, found in the proportion of 10 to 17 per cent. in the feldspar of granite, have not yet been extricated from the feldspar by any process for the use of the arts, but they are constantly evolved by the natural decomposition of the mineral, probably in a great measure by the action of the carbonic acid of the atmosphere and by the vegetable acids.

The granular quartz or firestone of Woonsocket, a member of the mica slate formation, is used by all furnaces in the Atlantic States. The mica fuses, and thus agglutinates the grains more firmly together.

Dr. Jackson is decidedly of opinion that the hornblende rock is of igneous origin; it sometimes passes into serpentine, and is associated with soapstone and magnesian carbonate of lime, (dolomite,) whose origin it is supposed may be from the transfer of magnesia from the hornblende rock to the limestone, "by some unknown chemical process," in accordance with the theory of Von Buch. Is not this a case where the proposed explanation presents a greater difficulty than the one it proposes to solve? "Hornblende rocks yield by their decomposition an admirable soil, warm and of good texture."

The magnesian limes of Rhode Island are much esteemed "for the quickness of their setting when converted into mortar, as also for the beautiful whiteness of the lime." Hence the lime made from the Smithfield "hard jointer" rock, commands a higher price than any other.

In Rhode Island, the transition slates, instead of being filled, as is usual elsewhere, "with fossil trilobites and marine shells, contain an immense number and variety of cryptogamous and cellular plants," the usual attendants of coal strata; "and in this deposit occur all the beds of anthracite of Rhode Island and Massachusetts."

"At the junction of the slates and granite rocks, various remarkable metamorphoses are seen, and the clay slate is either cemented into mica slate, flinty slate, or even scoriæ filled with epidote, as may be seen on Newport Neck."

Dr. Jackson is of the opinion that both on the eastern and western continents, a great deluge of waters has rushed from the north south-

* Or *Confervæ*, see notice in this No. p. 174.

wardly, bearing before it immense masses of debris, and depositing them far to the south of their original places. Around the city of Providence and on the island of Rhode Island are found bowlders of porphyritic iron ore, that have been transported many miles from their native bed in the iron mine hill in Cumberland; the bowlders near Providence being two or three feet in diameter, decreasing in size as we go south, until they are not larger than a cannon ball. "The width of the line of deposition is about eight or ten miles." None of the bowlders of the Cumberland iron are found to the north of the iron mine hill, while to the south they are so abundantly scattered in the soil that most of the fences are constructed of them. Diluvial scratches and striæ are very numerous, and the direction is generally N. 5° E., S. 5° W.—the variation being about 7° 30′ W.—so that the direction is very nearly in the meridional line, thus indicating the course of the ancient current which has polished the hard rocks more or less.

Dr. Jackson carefully collected and analyzed the useful minerals, and their extent was measured or estimated with great care. The exploration for coal in Cumberland has been abandoned, after penetrating twenty eight feet through loose materials, and the entire shaft was sixty seven feet deep.

Diamond hill is composed of quartz rock, partially agatized, and containing jasper, druses of quartz crystals, phosphate of lime, and veins of red hæmatite iron ore, and is much visited by mineralogists on account of the beautiful specimens of agate, chalcedony, and quartz crystals, that abound in it, "and which are especially beautiful at its summit, where they can be easily broken off from the huge detached masses of rock," as we had occasion many years ago to observe.

The iron mine hill is a mass of porphyritic magnetic iron ore, 462 feet in length, 132 feet in width, and 104 feet in height, above the adjoining meadow; containing, at the rate of 240½ lbs. to the cubic foot, 6,342,336 lbs., and composed of oxides of iron 40 per cent., silex 23, titanium 15, alumina 13.10, magnesia 4, manganese 2. This hill of ore seems to have been protruded through the granite and gneiss contemporaneously with the serpentine veins in the vicinity. Its origin would appear to have been the same with that of the iron mines of Missouri.

Near Sneech pond is a remarkable bed of manganese, whose composition is silex 26.4, protoxide of iron 35.9, protoxide of manganese 32.8, carbonic acid 5.2.

Beacon hill, in Cumberland, so called from its displaying a beacon light in the American revolution, is composed of granite.

Much limestone is burned in Smithfield; the kilns contain 500 casks of lime, and by the wearing away of the walls they become so large as to contain 550 or 600 casks, which are worth about 1300 dollars. The calcined lime is very nearly as bulky as the limestone, and is said to lose only one third of its weight in burning, instead of 44 per cent. of carbonic acid, which it contains if pure. The lime made from the magnesian or hard variety is preferred by masons, as the mortar hardens sooner than if made of pure lime, as the magnesia renders it somewhat hydraulic. Dr. Jackson is of the opinion that lime, properly burned by anthracite, is equal in whiteness and strength to that burned by wood. The kilns connected with the Dexter rock have been wrought for more than eighty years, and during the last forty they have produced not less than 10,000 casks per annum.

The mineral called rhomb spar is said by our author to be erroneously named, for it is not a magnesian carbonate of lime, but contains a considerable proportion of carbonate of manganese.

On Moshassuc stream, there is a bed of soapstone or talcose rock, twelve feet wide, included between walls of chlorite slate; it is very useful as a lining to the lime kilns.

On page 70 of the report there is a section exhibiting, very palpably, the passage of a conglomerate into a mica slate, the fine grained varieties of which have afforded from 5 to 17,000 dozen whetstones annually—the last year 10,000 dozen, or 120,000 stones.

The beautiful crystals of amethyst formerly found near Bristol ferry, are exhausted.

Mount Hope, the seat of the celebrated Indian warrior Philip, king of the Pequots, is 193.6 feet high: it is composed of granite and quartz, and a clear spring of water still flows near the site of the ancient wigwam.

"Warwick neck is entirely underlaid by the rocks belonging to the Rhode Island coal formation, the fine grained graywacke and the carbonaceous clay-slates, charged with numerous impressions of fossil plants and with narrow seams of anthracite and plumbago." The upper surface is here tertiary.

In the town of Natic, there are bowlders containing a new mineral, which Dr. Jackson has called Masonite.* There are no similar rocks in place nearer than the town of Ward, in Worcester county, Mass. One of these rocks weighs 64 tons, answering to 600 cubic feet, being 15 feet long, 10 feet wide, and 4 feet thick. The new mineral is a silicate of alumina and protoxide of iron, plus silicate of manganese, plus water—or water 4, silex 33.2, alumina 29, magnesia .24, protoxide of iron 25.93, oxide of manganese 6.

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* In honor of Mr. Owen Mason, of Providence.

Near Newport, on the sea shore, there is a large vein of quartz thirty feet wide, cutting through slaty rocks. In this vicinity are numerous beds of anthracite from one foot to three feet in thickness, and the slate rocks of carbonaceous clay containing them are charged with myriads of fossil plants. The intrusion of granite has here produced the usual appearances of hardening—vitrification and scoriæ, and there are beds of intruded serpentine at Willow Grove, near Fort Adams.

With the geology of this island we were early familiar, and traversed it many times with the late Col. Gibbs, in 1807, and we are much impressed with the correctness of Dr. Jackson's views of the conglomerate at Purgatory, two miles east of Newport. The pebbles of hard quartz are from an inch to a yard long; they are all ovoidal, and lie with their longest diameters parallel to each other, as if swung around by a strong current, like ships at anchor; the surfaces of the pebbles are polished as if by long abrasion of water and sand, and they are firmly cemented by a finer paste of a similar nature, but apparently fused, their surfaces being often covered with an infinity of minute crystals of magnetic iron ore, which often also forms a part of the cement. We have remarked also that the slaty graywacke in the same vicinity, has similar crystals, often distinctly octahedral, and if with Dr. Jackson, we attribute the one to the operation of fire, we must assign the same origin to the other. There is a rent in this conglomerate from eight to ten feet wide, and from thirty six to forty four feet deep. This fissure was once occupied by a trap dyke, most of which has been washed away by the sea, which, especially in easterly storms, roars and dashes into this fissure. The power that uphove the rock, has cracked the pebbles accurately in two, like plumbs divided by a knife in a pudding.* In Portsmouth, near the north end of Rhode Island, there are important strata of anthracite which were once extensively wrought, but the exploration was given up about fifteen years ago. The strata were stated to be three in number, and varying from two to twelve feet in thickness.

By Dr. Jackson's analysis, a clean specimen of this coal gave water and volatile matter 10, carbon 84.5, dark red ashes 5.5. A specimen of the rusty coal, gave water and volatile matter 7, carbon 77.0, dark purple red ashes 16—consisting of silex 7.4, oxide of iron, alumina, manganese, and a little lime, 8.0. This is a valuable coal, as we have had occasion to know from experience; and we stated in Vol. XIII, p. 78, of this Journal, the quantity of inflammable gas

* The name Purgatory, popularly applied to this fissure, is said to have arisen from a lover's leap having been made across the gulf to please and win a fair maiden; and the fortunate lover at once declared his transit from purgatory to paradise.

obtained from it; when moist, it yields a large quantity; when dry, very little. Dr. Jackson considers the 10 per cent. of water, as water of composition; but we have found that this coal, after lying a long time in a hot and dry garret, afforded very little gas at ignition, but gave abundance when moistened. The author is of the opinion that this coal will answer well for furnaces but not for parlor grates, as the ashes will form slag; but he does not donbt that the mines may be profitably wrought, and that the coal exists in sufficient quantitiy to justify thorough working of the mines. He has given very valuable comparative statements respecting the properties of the various anthracites of our country, and has described particularly the mines of Mansfield, in Massachusetts, which are in the same geological formation, but our space does not permit us to quote these valuable remarks. We trust the time is not distant when the mines of Rhode Island and of Mansfield will be again explored, and with decisive advantage.

Block Island, twenty five miles from Newport, and fifteen from Point Judith, is a very small territory with tertiary surface of granitic origin, and presents little that is interesting in geology beyond numerous peat beds, bog-iron ore, clays, sand and bowlders: the latter are of granite, and are identical with those on Point Judith and at Kingston, on the continent, while they rest on a substratum of blue clay, upon which they must have been deposited by diluvial causes—water and ice, aided by winds and currents. There are no shells in the clays of this island, which sometimes form cliffs of seventy to one hundred feet perpendicular, while the hills rarely exceed one hundred and fifty feet above the sea level. There is no harbor—the boats are drawn on shore by oxen when a storm is at hand; the sea washes away the land in some places, and the best defense is the long line of bowlders which fortify the coast, and repel the buffeting of the waves; to remove them would therefore be very injudicious.

This island, with fifteen hundred industrious inhabitants, is fairly entitled to a breakwater, or artificial harbor, to be erected at the expense of the general government.

2. *Some notice of the Agricultural part of Dr. Jackson's Report.*

This report is characterized by the extent of its agricultural observations, and by the great number and accuracy of chemical analyses of soils, peats, limestones, and other substances of interest to the practical agriculturalist. Nearly two hundred of these analyses are given, which have been performed chiefly on the soils, &c. from Rhode Island. Dr. Jackson has not however in this report confined his researches exclusively to that state, but has sought for facts and information from the practical farmers of Massachusetts, and examined soils from various and widely different parts of the world, whenever he thought the information thus obtained would elucidate the general subject. We cannot here enter into the details of farm reports, however interesting it may be to know the history of individual experience in relation to matters so important as the routine and results of agricultural practice. Much has been written, especially in this country, on the analysis of soils and the possibility of adopting some short-hand method, whereby every man may become his own analyst. When we consider however the very small difference which exists between barren and productive soils in the proportion and number of their constituents, we must agree with Dr. Jackson in concluding, that "nothing short of a thorough and complete analysis can prove serviceable to agriculture." p. 189.

The mode adopted in these analyses in order to ascertain the *inorganic* constituents of the soil was substantially as follows: 1. A given quantity, say 100 grs., is dried on glazed paper at a temperature a little above 212°; the loss of weight it thus sustains is noted as hygrometric moisture. 2. Placed in a platina crucible, first over a lamp, and then in a muffle, and gradually heated to full redness, the loss sustained is set down as answering to all the organic matter. 3. Place this burned soil (2) in a green glass flask and cover it with pure water; drop in muriatic acid, and note if there is any effervescence; if so, there is a carbonate (probably of lime) in the soil. Add more acid, and boil until all that is soluble in the acid is taken up. Dilute, filter, wash, dry, and weigh the remainder—the loss is all that could be taken up by vegetation, and consists of salts of lime, iron, alumina, potash, manganese, magnesia, &c. The residuum is the insoluble silicates, which weigh. 4. Boil the solution (3) in a green glass flask, having previously added nitric acid to peroxidize the iron. While warm, precipitate the iron and alumina by caustic ammonia; simmer the whole for a few minutes to condense the bulky precipitate; filter and wash for twelve hours with hot water, place the precipitate in a silver crucible and boil it with caustic potash till all the alumina is taken up; dilute, filter, and wash again. 5. The alumina is thrown down by carbonate of ammonia in water, added to the alkaline solution previously acidulated by muriatic acid. Wash it for twenty four hours with hot water, burn the filter, and note the weight.* The ammoniacal solution (4) from which the iron and alumina have been removed, is now treated with oxalate of ammonia, which will precipitate the lime as oxalate of lime. Collect and wash this precipitate and expose it to a dull red heat in a platina crucible, letting fall on it a few drops of carbonate of ammonia to convert the

* All the foregoing and subsequent precipitates are collected on double filters, which are burnt afterwards and weighed against each other, the difference of weight being credited to the precipitates.

oxalate of lime into carbonate; note its weight. 6. Add to the ammoniacal solution (4) from which the lime has been thrown down, phosphate of soda—if any precipitate occurs it will be magnesia, in the state of bi-phosphate, 40 per cent. of which may be set down as magnesia. 7. Now lastly run a current of sulphuretted hydrogen through the remaining solution; if manganese is present it will fall, and may be reduced to black oxide.

In order to ascertain the existence of alkaline salts, burn off the vegetable matter from another 100 grains, and digest in a little nitric acid; dilute and filter, and evaporate to entire dryness; fuse the resulting salts and add a trifle of prepared charcoal—if any nitrates are present, deflagration will ensue, and the alkaline bases will be converted into carbonates.* Such is the method pursued in the analysis of the inorganic constituents of the soil; and we can, from having personally spent several weeks in Dr. Jackson's laboratory, confidently assert, that no labor or pains was spared in carrying it out in every detail, both on the part of himself and his assistants.

As an example elucidating the foregoing, we quote—"The following analysis of the rich alluvium of the Nile in Egypt, a soil celebrated from the remotest antiquity for its luxuriant vegetation, will serve as a good example. The analysis was made in my laboratory, and under my supervision, by my highly esteemed friend, Benjamin Silliman, Jr., who received the soil from Rev. George Jones, U. S. N., who took it himself during a visit to Egypt in 1835. I shall give the process of analysis, as an example of our methods.

"The soil consisted of the annual layers deposited by the Nile during its periodical overflowings. It contained some fine particles of mica, deposited between its layers, but was destitute of any pebbles or sand. It is of a deep brownish yellow color, and splits readily into thin leaves when dry. The soil having been crushed fine, was sifted through a gauze sieve, and no sticks or fragments of rocks were found, excepting the fine particles of mica above mentioned. One hundred grains of the soil dried at 300° F., lost 7.05 grains, which was water.

"Its vegetable matter was then burned out in the platina crucible, placed in a red hot muffle, and the loss was 6.9 grains, which was vegetable matter. Digested in muriatic acid 23.432 grains were dissolved, and 68.7 consisted of the insoluble silicates. The analysis having been at this stage lost by accident, was renewed, and 100 grains of the soil previously dried at a temperature above that of boil-

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* It will be seen by reference to the analysis of the Nile soil that this method is not always conclusive, and we cannot doubt if Dr. Jackson had practiced the method of Mitscherlich, he would have found more proofs of the existence of potash in the soils of Rhode Island than he has given them credit for.

ing water, but not sufficient to brown the glazed paper on which the operation was performed, lost on being burned, 6.90 grains of vegetable matter.

"The soil was then mixed with four times its weight of carbonate of potash, and was fused at a full red heat in the platina crucible, so as to render the whole soluble in water. The mass was then dissolved out from the crucible by means of boiling water, and was acidulated with muriatic acid, and then evaporated to entire dryness, so as to render the silica insoluble. The whole mass was then rubbed to a fine powder with an agate pestle, and moistened with muriatic acid. Then all the matters soluble in acidulated water were taken up by means of distilled water. The whole was then poured on a double filter, and the silex was collected, washed until pure, dried and ignited; the second filter being burned and counterpoised against it. The silex weighed while warm amounted to 47.39 grains. The solution that had passed the filter was then treated with a little nitric acid, and boiled to peroxidize the iron. Ammonia being then added in slight excess, the alumina and peroxide of iron being precipitated together were collected, and washed thoroughly for several days with boiling water, until the water came through the filter pure. The alumina and peroxide of iron were then separated by means of a boiling solution of pure potash, in a silver crucible. When all the alumina was taken up by the potash, and the iron had subsided, it was filtered in a double filter, and the peroxide of iron being collected, washed, dried, ignited, and weighed, amounted to 11.20 grains. The alumina was separated by neutralizing the alkaline solution, and was then precipitated by means of a solution of carbonate of ammonia. When collected on a filter, washed, dried, ignited, and weighed, it amounted to 32.10 grains.

"The solution from which the alumina and iron had been separated, was then treated with a solution of oxalate of ammonia, and the lime was precipitated in the state of an oxalate, and when collected, washed, dried, ignited, and converted into a carbonate, weighed 2.85 grains. The remaining solution being tested for magnesia, gave no trace, but a little manganese was detected by hydrosulphate of ammonia.

"Results of this analysis of the dry soil:

Vegetable matter,	6.90
Silex,	47.39
Alumina,	32.10
Peroxide of iron,	11.20
Phosphate and crenate of lime,	2.02
Manganese, traces,	
	99.61

"The amount of vegetable matter soluble in a solution of carbonate of ammonia, is 1.25 grains, and a solution of carbonate of potash takes up 1.8 grains.

"The vegetable soluble matters analyzed, were ascertained to be the crenic and apocrenic acids, with a little crenate of lime."

We would add, that the method by which this analysis was performed, seems defective in not testing for the presence of carbonic acid in the soil before heating to full redness, whereby, in all probability, the carbonic acid is expelled; for we have since obtained satisfactory proof of the existence of carbonic acid in the Nile soil.* This soil was judged to contain no potassa on the evidence yielded by the trial prescribed in the present plan of analysis, (by digestion with nitric acid and deflagration with charcoal.) But Professor Mitscherlich has shown that the existence of potassa in aluminous soils may be much more satisfactorily proved by digesting them with sulphuric acid, when if any potash is present alum will be found. We accordingly digested 200 grains of Nile soil in dilute sulphuric acid, filtered it, and evaporated the solution to entire dryness, redissolved in distilled water, and on concentrating the solution, (which had a very strong taste of alum,) obtained distinct crystals of sulphate of alumina and potassa. This result is satisfactory, inasmuch as it makes the analysis coincide more nearly with those which have been before published from the same country, all of which represent the soil as containing potash.

The method pursued in estimating the organic constituents of soils, was different from that which has been generally followed in similar cases, and entitled to much confidence. So far as we are informed, Dr. Jackson is the first who has proved by reiterated trials, that the so called humus, geine, apotheme, &c. of previous authors, is mainly composed of two acids, first discovered by Berzelius† in the waters of Porla Well, in Sweden, and called by him (from κρηνη, a fountain) crenic and apocrenic acids. They communicate to that water a bitter taste and slightly brown color, and have been fully described by him in the memoir before the Stockholm Academy in 1833, before cited. We cannot here give any account of the properties of these acids, nor is it necessary, since their history may be found detailed in the standard works. (See Thomson's Chemistry of Organic Bodies, Vegetables, 1838, p. 153 et seq.)

Whoever will read with attention the profound work of M. Liebig, noticed in this number, will feel, if his conclusions are to become the

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* Consequently the 2.02 of phosphate of lime in the above analysis, would probably be nearer the truth if it read *carbonate* instead of phosphate of lime.

† *L. c.* p. 178.

standard of our present belief on this subject, that we are henceforward to consider humus as playing a much less important part in the nutrition of vegetables than has heretofore been attributed to it. We are to consider it rather as a slow and inexhaustible source of carbonic acid, which is continually given out by it in its various stages of decay until it attains the condition of perfect mould; still it cannot be divested of a certain degree of importance, since, as a general rule, it is a usual constituent of fertile soils. But the instances adduced by Prof. Liebig as to its solubility in water, even in its most soluble form, the crenate of lime, go far to prove, that water alone is never the means of conveying it into the animal organism. Yet it must ever be allowed to be a proof of discernment and analytical skill on the part of Dr. Jackson, to have proved so conclusively as his numerous experiments seem to do, the identity of the principal mass of the substance called humus with crenic and apocrenic acids.

The methods followed by Berzelius, in his analysis of the ochre from Porla water, were found inadmissible in the case of soils, for caustic potassa takes up a considerable portion of alumina and silica, and decomposes several saline combinations occurring in soils. The alkaline carbonates are decomposed by the crenic and apocrenic acids, the alkali combining with them. Carbonate of potash was accordingly at first employed, in accordance with the recommendation of Dr. Dana; but it cannot by washing be entirely removed from the soil; and the subcarbonate takes up a portion of the alumina. Carbonate of ammonia was accordingly tried, and with perfectly good success, for it can be entirely washed from the soil, and takes up all the organic matter which can be supposed to be useful in vegetation, offering therefore the best means for comparative experiments. In practice, a given weight of the pulverized and dry soil to be examined, is placed in a glass flask and covered with a solution of carbonate of ammonia in pure water, saturated at 60°; this is then placed in a situation where the temperature is about 170°, or the solution may be gently boiled. When it is judged that the carb. ammonia has taken up all it can, turn off the dark brown solution upon double filters previously counterpoised. Repeat the digestion with the ammoniacal carbonate as long as the soil imparts to it any color. After washing well the filters and drying them with the insoluble matter in the drying closet, counterpoise the filters against each other and ascertain the difference of weight; the loss is soluble organic matter taken up by the ammonia. The soil may then be burned in a platina crucible, and the loss is insoluble vegetable matter. Acidulate now the ammoniacal solution with acetic acid, and drop in gradually a solution of acetate of copper. The brown flocculent precipitate which falls is apocrenate of copper.

Let the whole stand in a warm situation over night, and when the precipitate has all subsided, filter on double equal filters, collect and wash the precipitate with distilled water. After carefully collecting and weighing the residuum, it may be decomposed by deflagration with nitre, solution in nitric acid, and precipitation of the deutoxide of copper by boiling potassa ; or otherwise by a current of hydrosulphuric acid gas, passed through distilled water, in which the apocrenate is previously suspended. Either of these methods gives a brown solution, after filtering, which is apocrenic acid, and may be evaporated on the air-pump, in a capsule of thin glass of known weight, and subsequently weighed, subtracting the weight of the capsule. The crenic acid still remains in the mother water ; to obtain it, render the solution alkaline by carbonate of ammonia ; heat it to expel all carbonic acid, and then drop in acetate of copper ; the crenate of copper falls as a greenish white precipitate ; treat it like the foregoing, and decompose it by hydrosulphuric acid gas ; filter and evaporate as before in a thin glass capsule ; a brownish yellow substance adheres to the sides and bottom of the glass, and on drying, scales up in brilliant chips. These substances, when tested as Berzelius directs, for the discovery of crenic and apocrenic acids, give results identical with those which he obtained.

There are many practical and very important observations on manures and composts, and the use of peat in particular as a prominent ingredient of composts. But we have already exceeded the space we proposed to devote to this notice,—and we congratulate the State of Rhode Island, as well as the author, on the great amount of valuable and interesting information which well directed industry has accumulated, in so short a time as one year. The best earnest for the continuance of governmental patronage to labors of this class, is found in the zeal, fidelity, and usefulness of the performance. B. S. Jr.

Yale College Laboratory, Jan. 1, 1841.

14. *History of Embalming and of Preparations in Anatomy, Pathology, and Natural History, including an account of a new process for Embalming; by* J. N. Gannal, Paris, 1838. Translated from the French, with notes and additions, by R. Harlan, M. D. Philadelphia, Judah Dobson, 8vo. pp. 264.

The art of embalming, as practiced by the Egyptians, has, like many other arts of that ancient people, fallen into oblivion, and the progress of enlightened civilization has rendered this loss of comparatively little consequence, if we view the practice only as a mode of complying with the requisitions of heathen superstition. But the science of anatomy has long stood in need of some mode, more effectual than any heretofore used, of preserving from speedy decay the subjects of dissection, and avoiding the miasmata incident to the decomposition of animal matter; and not unfrequently affection seeks to prolong the period between the death and burial of some relative or friend, especially when this event has occurred at a distance from the residence of the deceased.

This desideratum is fulfilled by the process of M. Gannal, which has received the sanction of the Academy of Sciences of Paris, and the Royal Academy of Medicine, whose commissioners have satisfactorily demonstrated the great utility and novelty of this mode of preserving dead bodies for dissection, without materially altering the organic tissues, or offering any injury to the instruments of the operator.

M. Gannal's plan is to inject through the carotid artery, upwards and downwards, a solution of acetate of alumina in water. The acetate of alumina is prepared by the acetate of lead and the sulphate of alumina and potass. This acetate of alumina, at 18° of Baume's areometer, and in the quantity of five or six quarts, is sufficient to preserve a body for five or six months, with scarce any alteration in color or appearance; after which time it desiccates, and the body becomes mummified and stiff. During this time putrefaction is completely arrested, and it is the testimony of M. Serres, of the School of Practical Medicine, that by means of M. Gannal's process they are enabled to prosecute anatomical demonstrations during the summer months the same as in winter, and that with thirty bodies at a time on the tables, no unpleasant odors arose, and seventy pupils could go through with all the operations in August and September, a thing before quite impossible.

The powerful preservative properties of aluminous salts, have been long known, and were not unfrequently resorted to by the ancients. Some remarkable instances of preservation by such a medium have accidentally occurred in our own country. That distinguished officer of the American revolution, General Wayne, died thirty or forty years ago, at Erie, Pa., and was buried in the vicinity of the lake; the body was not long since disinterred and removed by his son, who was astonished to find it in so perfect a state of preservation, and on examination it was discovered to have been deposited in argillaceous soil strongly impregnated with a solution of alum.*

The translator, Dr. Harlan, has done a service to the medical profession, and to all naturalists engaged in zoological investigations and collections, in placing this book before them. Whoever reads it cannot fail to observe that M. Gannal has made a great advance in this branch of knowledge beyond the unmeaning empirical balms of his

* The features were recognized by those who had known Gen. Wayne.

predecessors; and he will likewise gain much instruction and entertainment from the history of embalming among the ancient Egyptians and Guanches, as well as in more modern times.

15. *A General Outline of the Animal Kingdom*, by T. R. Jones, F. L. S. London, 8vo. parts 1 to 10, pp. 480; to be continued; price 2s. 6d. per No.—This work is confined to the physiological and structural peculiarities of the great groups, classes, and orders of the animal kingdom; and, from being lucidly written and beautifully illustrated, it cannot fail to become a manual of comparative anatomy and animal physiology, extended through all the classes of the animal kingdom. This, it is well known, has long been a desideratum in our literature; and we are, accordingly, the better pleased to see it so well executed. The inferior tribes of animals, whose structure and economy, and even existence, are almost unknown to the majority of English readers, are treated in a manner which will, we trust, gain for them numerous observers in this country, affording as they do such singular materials for investigation.—*London Athenæum.*

16. *Boston Journal of Natural History, containing papers and communications read before the Boston Society of Natural History*, Vol. III, No. 3. Boston, 1840; C. C. Little and J. Brown.

Our readers have for two or three years past been familiar with all that has been done by this active Society, as far as it has been published in the reports of their weekly meetings. One of the papers contained in this part of their Journal, appeared at length in our last number, viz. that by Mr. F. Alger, on the minerals of N. Holland. The contents of the present number are as follows:

Art. VI. A further examination of some N. England Lichens; by Edward Tuckerman, LL. B.

Art. VII. Notice of Minerals from N. Holland; by F. Alger.

Art. VIII. Descriptions of eleven new species of N. England Shells; by Prof. C. B. Adams.

Art. IX. Description of Tellina tenta, Say, and of Helix serpuloides, Montague, with remarks on other marine shells of Massachusetts; by C. B. Adams.

Art. X. Description of the Fishes of Ohio river and its tributaries; by Jared P. Kirtland.

Art. XI. A Monograph of the Helices inhabiting the United States; continued, by Amos Binney, M. D.

Art. XII. Description of two new species of Anculotus; by J. G. Anthony.

Art. XIII. Monograph of the species of Pupa found in the United States, with figures; by Augustus A. Gould, M. D.

17. *Supplement to the Introduction to the Atomic Theory; comprehending a sketch of certain opinions and discoveries bearing upon the general principles of Chemical Philosophy; prefaced by some remarks on the projected reforms in academical education.* By CHARLES DAUBENY, M. D., F. R. S., L. S., G. S., M. R. I. A., Professor of Chemistry and Botany in the University of Oxford.

This work has many claims to attention. The remarks "on the projected reforms in academical education" are appropriate, and are applicable to academical education in this country as well as in England. Regarded as a brief exposition of the leading doctrines of chemistry, divested of their technicalities, and embracing the points of general scientific interest, this essay possesses great merit. Those who may desire to obtain a knowledge of only the general principles of chemical philosophy, will find them ably developed in Dr. Daubeny's sixty two pages.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Horticultural Experiments;* extracted from a letter from Dr. J. T. PLUMMER.—For some years past I have been experimenting in a horticultural way. I till my garden with my own hands, and take great delight in it. It not only furnishes a wholesome exercise, but it affords me a much relished mental recreation, in watching the curious developments of the vegetable world, its recuperative powers, and indeed its pathology and physiology generally. Part of the experiments which I have made are intended to show at what average temperature at noon various seeds will germinate, and how many days are requisite for them to vegetate at any given temperature. Thus I find that the Lima bean, at a temperature of 88°, (in the shade,) will appear above ground in seven days; at a temperature of 62°, it requires twenty days. The marrowfat pea, at 51°, requires nineteen days; and at 74°, only eleven days. Radishes vary with the temperature from six to twelve days. Thus the average temperature of any country, *other things being equal*, may be inferred with considerable accuracy, from the periods of vegetation; for in looking over my long list of recorded experiments, I find a great degree of uniformity in the process of germination, in ordinary circumstances.

After various experiments, I have succeeded in ridding my peas of the bug, (Bruchus pisi.) Immediately after gathering the seed, I subject them to the action of boiling water *one* minute; by this means I destroy the little grubs, or larvæ, which at this time are just below the integuments of the pea, without destroying the vitality of the seeds. If the peas remain in the boiling water *four* minutes, most of them will be killed, but not all; of about forty peas thus treated last year, three vegetated and are now growing. The corcle I find is more tenacious of life than the cotyledons.

I have recently analyzed some of the soil of our woodlands, and I find in 100 grs. of the dried earth, 4.5 grs. of geine, 7 grs. of insoluble geine, 2.25 grs. of salts of lime, (principally carbonate,) 12.5 grs. aluminous matter, and 74 grs. siliceous matter. A hundred grains of earth yield about half a grain of phosphate of lime, but not the least trace of *sulphate* of lime; and yet the soil produces plants which contain this salt. I should mistrust my means of delicate analysis, did not the sulphate generally exist in larger quantities than the phosphate. A protracted decoction of several hundred grains of earth yielded no precipitate with barytic solutions.*

Richmond, Indiana, April, 1840.

2. *Volcanic Ashes.*—The following memorandum has been handed to us by Rev. Peter Parker, M. D., who was a passenger in the Niantic from Canton to New York.—Eds.

Ship Niantic, L. F. Doty, master, April 5th, 1840, being in lat. 7° 05′ north, lon. 121° 10′ east, at 2h. A. M. sixty miles west from Mindanao, one of the Phillipine islands, came up a fine breeze from the northeast, which was attended with a shower of dust resembling that of ashes. It came so thick that it obscured the moon and stars, which were all out very clear before; it filled the sailors' eyes so full that they were obliged to retreat from the deck below; it lasted about one hour, and cleared away. At daylight, the Niantic looked like an old furnace, completely covered from the royal-mast-head down to the water's edge. The decks I should judge one quarter of an inch thick with the ashes; we took up one half bushel, and might have saved three or four. It fell in small quantities at different times for two or three days after. On the 14th of April, spoke the English barque Margaret, *whaler;* reported likewise on the 5th of April had a similar shower of ashes, being at the time three hundred miles north northeast from us; he informed me that on the 12th of April, he visited several villages on the island of Madura entirely deserted by the people, from one of which he had taken two brass cannon and several other articles. This led us to think that some volcanic eruption had lately happened in that neighborhood. After the 9th, perceived no more in proceeding northward.

July 23d, 1840.

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* We conceive that this is not conclusive, for in all probability the sulphate of lime, if it exists in the soil, is converted into carbonate by the alkaline carbonate with which the soil is digested.—Eds.

3. *African Meteorite of Cold Bokkeveld.*—A notice of this meteorite was given in this Journal, Vol. xxxvii, p. 190. By the kindness of the Rev. G. Champion, late missionary in South Africa, we have recently received the South African Commercial Advertiser of Dec. 11, and another of Nov. 27, (of themselves interesting curiosities,) from which we extract the following particulars.

It is stated in the paper of Nov. 27, that the event occurred on the morning of Oct. 12, 1838. There was a cloudless sky without wind, when, say the Hottentots Kieviet and Rattray, both under oath before a magistrate, about 9 o'clock we heard a strange noise in the air, resembling the loudest thunder we had ever heard; and on looking up we perceived a stream passing over onr head, issuing a noise which petrified us with terror: a burst took place close to the waggon,* when something fell and a smoke arose from the grass. My master sent me to look what it was that had fallen; when I found a stone quite warm, so much so that I could not hold it in my hands. It might have been then of the weight of seven or eight pounds. In the paper of Dec. 11th, is a detailed statement signed Thos. Maclear, at the Royal Observatory, Dec. 7, 1839, a principal object of which is to correct the date of the fall of the stones, making it the 13th instead of the 12th of October, 1838. From this statement we select the following particulars.

The Cold Bokkeveld is an irregular valley or bason, bounded by high rugged mountains, as is also the case with the basons of Worcester and Tullogh. The report was heard fifty miles from the Bokkeveld: of the two reports heard at Worcester, it is probable that the second was an echo from the mountains,† as only one report was heard in the Bokkeveld. To Judge Menzies and Mr. George Thompson, who were travelling ninety miles east of Cold Bokkeveld, the meteor appeared to explode nearly over their heads—a decisive proof that it was much elevated at the time. Mr. Maclear visited the Bokkeveld on purpose to examine the eye-witnesses in person. Mr. Thompson states that at about 9 o'clock, A. M. October 13, the meteor appeared to approach from the west with great velocity and precisely similar to a large congreve rocket; it expanded (exploded?) nearly over head, apparently not more than three hundred to four hundred feet high, dispersing in large globes, the size of forty two

* With which they were getting wood.

† A very fine series of echoes is heard from the door of the Mountain House among the White Mountains of New Hampshire, when at the hour of retiring for the repose of night a horn is vigorously sounded or a piece of artillery discharged; the reverberations are very distinct, and prolonged until they die away insensibly in the distance.

pound shot, of quicksilvery appearance, then fell for a few seconds towards the north and vanished. No report was heard by Mr. Menzies and Mr. Thompson, (a sufficient proof of the great distance,) for on reaching the Bokkeveld, almost one hundred miles, they ascertained that the meteor had exploded and stones fallen there about the time they witnessed the phenomenon.

The Rev. Mr. Zahn, of Tubogh, sent in to Mr. Watermeyer a stone broken by the fall into two pieces, the same stone that was analyzed by Mr. Faraday; it weighed twenty seven ounces—another weighed four pounds two ounces avoirdupois.

Several stones fell on the place of Rudolph Van Heerden, one of which was broken to pieces by falling on the hard road; another sunk a few inches into the ground on a ploughed field, and a third penetrated several feet in a moist place near the water. The first stone named above, fell at an hour's distance (five to six miles) from the others; and in the same direction in which the agitation was perceptible, i. e. from northwest to southeast, more stones were found. Mr. Zahn states that he had one piece too large to be carried on horseback.

Dr. Truter, civil commissioner of Worcester, at the time of the fall observed the windows of his office to shake as if by an earthquake, and the mercury in his barometer was found to be depressed to the lowest point of its range throughout the year. Dr. Truter sent in several specimens of the meteorite seen to fall by the Hottentot Kieviet.

Attention was first excited by a violent explosion, followed by a rumbling noise, like that from heavy wagons passing over stony ground; when, on looking up, they saw a blue stream of smoke, as if from fired gunpowder, passing over from S. W. to N. E.; at the same instant the son of Van Heerden saw something fall, which he picked up; and another stone, which plunged into a marsh about a mile off, was afterwards discovered.

A servant of Priter du Tort, saw a stone fall in the brush-wood, a mile below the garden; he ran to the place and brought it to his master. All assert that the sky was clear and calm, and that the stones were so hot that they could not be taken up.

All the instances cited above, are those of stones that were seen to fall.

The people being excited, farther search was made, and many other pieces were discovered within a zone of one mile broad and sixteen miles long, only a small portion of which is cultivated, and the remainder is covered with brush-wood as on waste land, and therefore it is highly probable that many other pieces have escaped observation;

especially as only six persons chanced to be within this tract at the time—two of them within a mile of each other—three close together, but about six miles from the first named, and one eight miles further on.

All that was obtained amounted to about twenty pounds avoirdupois, and the analysis has been already given in this Journal, (Vol. XXXVII, p. 190.) We are much impressed with the similarity of this occurrence to the famous Weston case, of Dec. 1807, of which a full account was published by Profs. Kingsley and Silliman, and which may perhaps be republished in this Journal, as the facts were exceedingly remarkable.

We are so fortunate as to possess a good specimen of the African meteorite, through the kindness of a friend in Boston. It corresponds with Sir M. Faraday's description, and is very different in appearance from any meteorite which we have seen.

Mr. Maclear concludes his account by saying that he has seen a fine meteorite in the hands of a farmer in the country; it was picked up nearly sixty years ago, by a Hottentot, who saw it fall, and by him it was given to his master, the grandfather of the present possessor. This man has refused fifty dollars for it, as the captain of a ship said it would secure the possessor against the effects of a thunder storm.

4. *Further account of the Shooting Stars of August*, 1840.—Dr. M. D. Benedict writes to me the following: "I was called at 11 P. M. on the night of Aug. 11, to ride about twelve miles from *Skaneateles, N. Y.* The person in company with me remarked that he had never seen so many falling stars, and my attention being thus drawn to the subject, I soon noticed quite an unusual number. As we rode along, we concluded to count, and in the course of two hours or a little more, I counted one hundred and twenty, and my companion about the same number. I had occasion to ride more or less every night in the month of August, and think that during most of that time these erratic visitors were more numerous than ordinary."

2. *Rochester, N. Y.* A friend has sent me the following observations. "On the morning of Aug. 10, 1840, I looked for an hour, commencing at 2h. 30m., chiefly toward the northwest. In this period, I counted fifty eight meteors, thirteen of them being quite large and leaving trains. Besides these, I saw indirectly about *twenty*,—either just as they disappeared, or merely the trains they left."

3. M. Quetelet informs me that at *Brussels* the sky was too cloudy for observation. The observations in other places given below are communicated by him. At *Parma*, in Italy, M. Colla with two other

persons, on the night of Aug. 10–11, (?) 1840, observed three hundred and fifty six shooting stars, as follows:—

From	8h.	23m.	to	8h	56m.	10
	9		"	9	59	27
	10		"	10	58	28
	11		"	11	59	30
	0	9	"	0	59	48
	1		"	1	59	38
	2	1	"	2	59	102
	3	2	"	3	55	73

During the night of Aug. 9–10, (?) 1840, the same observers saw one hundred and eighty shooting stars, as follows:—

From	8h.	49m.	to	10h.	56m.	2
	11	19	"	11	48	4
	0	6	"	0	59	34
	1	5	"	1	59	47
	2	0	"	2	59	69
	3	3	"	3	33	24

At *Ghent*, on the night of Aug. 9–10, 1840, Prof. Duprez observed alone, ninety seven shooting stars, as follows:—

From	9h.	30m.	to	10h.	5
	10		"	11	11
	11		"	12	13
	12		"	1	19
	1		"	2	49

Sir J. F. W. Herschel states, that of twenty six considerable meteors, which he observed at *Collingwood*, Eng., between 13h. 25m. and 14h. 20m., on the morning of Aug. 10, 1840, twenty four radiated very precisely from γ Persei. On the 10th Aug. 1839, the radiant point, according to his observations, was β Camelopardali.

E. C. H.

5. *Meteors of November.*—The year 1838 appears to have been the last of the late annual series of the November meteoric showers. None was observed here, or elsewhere so far as we have learned, in 1839; and such is also the result of observations for the present year. On the night of the 11th I was on the look-out, but the sky was constantly overcast. On the night of the 12–13th, in company with a friend, I watched until 4 o'clock. It was cloudy the greater part of the night, but clear about half an hour between 3 and 4,—at the very time when, according to former observations, the meteors might have been expected in greatest frequency; yet we saw but a single shooting star. On the morning of the 14th I was up at 4 o'clock. The sky was clear, but no meteors were seen.

Mr. Herrick and two of his friends were on the look-out on the *evening* of the 13th, from 6h. to 6h. 30m., in which time they saw *ten* shooting stars; but on the *morning* of the 14th, from 3h. 15m. to 4h. 15m., he saw (watching alone) only *five*. These, however, emanated from the usual point in the constellation Leo, and moved with extreme velocity.

Dr. Parker, then on his return from Canton, on board of ship in the Atlantic, observed the heavens frequently during this period, with particular reference to this phenomenon. The sky was favorable, but he saw no signs of a meteoric shower.

The foregoing facts induce us to believe that this remarkable visitation of meteors has passed by, after a recurrence for ten or eleven successive years. We have indeed no records of it before the year 1830; but supposing that the extraordinary exhibition of 1833 was the middle of the whole series, when the phenomenon reached its maximum, and knowing as we do, that from this time it rapidly declined until 1838, after which it ceased altogether; we have reason to infer that it commenced the same number of years before 1833, namely, in 1828, although it did not arrest attention, so far as we have learned, until 1830.

As 1799 was the maximum of its previous return, we might infer that the cycle is thirty four years; but, on the supposition that the phenomenon arises from a conjunction of a nebulous body with the earth, near the node of that body, the intervals of such conjunctions may be very various, like the transits of Venus; and hence ages may pass before the return of another period of the meteoric showers of November, like that which we have seen. That such a termination of the present period is entirely in accordance with the expectations entertained by me from the first, will be seen by reference to my papers on this subject, in the different volumes of this Journal. DENISON OLMSTED.

Yale College, Dec. 31, 1840.

6. *Meteoric Observations in October and December*, 1840.—As there was some expectation that an unusual frequency of meteors might be detected in the early part of October, I watched a while on the mornings of the 7th and 8th, between 4 and 5 A. M., but saw nothing uncommon, the number of meteors noted being at the rate of 12 an hour, (for one observer.) The sky was cloudy on the 9th and 10th.

On the evening of the 6th of December, 1840, a snow storm prevented all observation for shooting stars. The nights of the 4th and 5th were also entirely overcast. The evening of the 7th was clear, but the moon was nearly full. Three observers watched from 6h. to 7h. P. M., and only *one* meteor was seen. The evenings of the 8th and 9th were too cloudy for observation. On the 10th, which was clear, I watched from 5h. 55m. to 6h. 10m. P. M., and saw but a single meteor. It seems probable, then, that the meteors of December 6th–7th, have this year failed. E. C. H.

7. *Meteorological Notes in* 1741–1757; by Professor John Winthrop, F. R. S.*—The following memoranda are copied from some old interleaved Boston almanacks of the years 1741–1757. They appear to have been made by John Winthrop, Esq., F. R. S., who was graduated at Cambridge in 1732, and became Hollis Professor of Mathematics and Natural Philosophy in 1738. It was thought that they were at least worth preserving, although the diary, to which reference is made in them, must (if yet in existence) be of far greater value. The astronomical parts are mostly omitted; there are besides, tables of mortality in Boston for several years, and some other observations of more transient interest. Should these notes prove of any value to meteorologists, the writer's trouble in copying them will be amply rewarded. E. T., Jr.

Cambridge, December 8, 1840.

"1741. *January* 10, *noon*. The greatest number of spots in the sun I ever saw. One I discovered with my naked eye, (using only a colored glass to save it.) Through telescope appeared to be a cluster of spots exceedingly black, and in company on all sides with a nebula; and besides these there were five or six in other parts of the sun. In the evening a considerable aurora, which about 9 o'clock was covered by the clouds. Till now the winter has been very severe, Boston harbor quite froze up—loaded sleds drive over Charlestown ferry, &c. 11. Snow. 12. A great thaw. 13. Cloudy, warm. About noon had a sight of the great spot in the sun with only the red glass.

"*March*. As hard a winter as was ever known. 5. An extraordinary aurora borealis. 6. Fair. 26. A very considerable aurora in the evening. 27. A fine day.

"*September* 25, 26, 27. Three charming days. 27. At night an extraordinary aurora, reaching from northwest to almost east: the eastern part often tinged with a bright scarlet, the bottom a very dark cloud, but so thin that the stars shined very brightly through it; the striæ changing every moment, and often reaching above the pole. The center seemed to the eastward of the north. I watched it till almost 1 o'clock. 28. A pleasant day; wind pretty fresh at southwest; at night a small aurora. Next morning a little rain. 29. Another aurora at night. 30. A great dew in the morning.

"*November* 4. A fine fall hitherto.

"*December* 6. A small earthquake felt at Boston, Roxbury, Dedham, Walpole, &c. about 8h. A. M.

* These extracts have at our suggestion been kindly forwarded to us by Mr. Edward Tuckerman, Jr. of Boston, in whose hands are the original notes of Prof. Winthrop. We doubt not they will be justly appreciated by meteorologists.—Eds.

" 1742. *February* 10. A considerable spot appeared near the sun's eastern limb, which seemed to have entered since yesterday. 12d. 5h. I saw it with only the red glass. Through the telescope it appears very black, surrounded with a nebula, but is only one spot. 14, 15. Snow and some rain.

" *April* 11. A considerable aurora in the evening.

" *October* 12. At night a considerable aurora.

" 1744. [ ] 23. A small earthquake about Newbury at noon.*

" 1745. *August* 4. A hurricane at Mansfield in Connecticut.

" 1746. *February* 2. A small earthquake between 9 and 10, P. M. I perceived it not.

" The aurora borealis on the 1st of March, 1746, was the greatest I have seen since the 5th of March, 1741. The evening was very fair and calm till about 9 o'clock, when a fresh gale sprang up at northwest by north, and then the meteor first began to appear in the north. I had no notice of it till 11 o'clock, at which time I accidentally discovered it. There was then the appearance of a black cloud in the north, about 5° high in the middle, and extending from about north northwest to near east by north. The fixed stars appeared very plainly through it. Immediately above it was a lucid arc considerably broader, very bright, but colorless, from which issued striæ tinged with a pretty vivid red, chiefly from its two extremities; and those from the western end, arose above the pole. The scene continued with short intermissions till midnight, and then the streaming ended, the meteor after this resembling a very str'g [ ]. About one in the morning I left it, finding no alteration in it nor any likelihood of new phenomena. The rest of the heavens appeared hazy, and the wind blew very fresh the whole time. The barometer was very low the whole month of February, and the last ten days was very cold, dry, blustering weather. The moon came to her last quarter the following night, which I should not have mentioned had not the judicious Dr. Halley, &c. It may not be amiss to subjoin a journal of the most remarkable auroras for seven years last past. That on the 22d of October, 1730, Phil. Trans., on the very night of the last quarter. Sept. 12, 1739, a very remarkable one, the striæ very red, exceeding the last, the night before the last quarter. Jan. 10, 1741, a considerable aurora, two days before first quarter; weather very severe. March 5, 1741, an extraordinary one, night before new moon. 26, a considerable one, two days before last quarter. Sept. 27, extraordinary, see almanack, night before new moon. April 11, 1742, considerable, three days before full moon.

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* The month does not appear.

"1746. *June* 1. A considerable aurora; began about 10, P. M. I watched it till 12. A uniform brightness (without any black cloud for a base) from northwest to northeast, about 30° high. Striæ reached up to the pole; those that were more permanent moved very sensibly to the west; a great many appeared and disappeared in two or three hours, only of a pale whiteness without any colors. At midnight it seemed to be almost over. This was seen in Canada. See Mem. Acad. 1747, p. 473.

"1751. *January* 22. From 10 A. M. till noon, very heavy storm of wind and rain. The wind about southeast, as high as ever I knew it; it did great damage at Cambridge, blowing down fences, barns, roofs of houses, &c. The barometer lower than I ever saw it—viz. 28.7 in. It was lowest at noon, and then the storm began to abate, and it presently cleared up. They had a violent storm at southwest the night before in South Carolina.*

"1755. *Nov.* 18. A violent earthquake. It began 11′ after 4 in the morning; [my clock, which was set right the noon before, was stopped by it at 11′ 35″.] It lasted at least four minutes. At 5h. 29′ the same morning, was another small shock. Evening, ye 22d, at 8h. $27\frac{1}{2}$′, another.

"1756. *Dec.* 19. Another small earthquake exactly at 10, P. M.

"*July* 4. At 6, P. M. a violent hurricane at Jamaica on Long Island. The barometer was then lower than it had been for five weeks before, and the day before it was higher; the fall in about 36h. being the range in the whole month of July, and greater than in the month of June. See the weather in the diary.

"*Nov.* 16. About 4, A. M. a small earthquake, which seemed not to last above 2″. All I perceived was the rattling of the window shutters by my bed's head. The sky was covered. Little or no wind. The weather moderate. It was more sensibly perceived in some other towns.

"1757. Aurora borealis 13th August, 7th, 13th, 14th of September, small ones; 12th November, a great one, very bright from northwest to northeast. I saw streamers up to the pole, and heard of some up to the zenith. It lasted bright all night. 13. Next night a small one. So that it probably lasted all Sunday.

"*July* 8. Exactly at $2\frac{1}{4}$h. P. M. a considerable earthquake, though but of short duration. The day was fair and hot, and there was a brisk gale at southwest. July 29, noon, a violent shock at Barbadoes, but no damage.†

"*Aug.* 13. Evening, Aurora borealis. None for a great while before."

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* The last sentence is an after note. † Ib.

8. *Galle's Three Comets.*—Mr. Galle, assistant observer at the Royal Observatory of Berlin, has discovered three comets in the short space of three months.

The *first* was discovered Dec. 2, 1839; it passed its perihelion Jan. 4, 1840, and was visible to the naked eye for a few nights in January as a nebulous star of the fifth magnitude.

The *second* comet was discovered Jan. 25, 1840; it passed its perihelion March 12, 1840. It was seen at several places in the United States, without, however, being visible to the naked eye.

These two comets are considered as new discoveries. Their elements do not agree with those of any that have yet been observed. Their motions may be perfectly represented by supposing them to move in a parabola, a curve which does not return into itself: so that no plausible conjecture can be formed respecting the time of their past or future appearances, except that the period of their revolutions cannot be much short of a thousand years.

The *third* comet was discovered March 6, 1840; it passed its perihelion April 2, 1840; its tail (visible only in a telescope) might be traced through several degrees. Its elements, compared by its discoverer in connection with Encke, show that it is the same as that which appeared in 1097 and 1468, and that its period is about 370 years. Its two last appearances occurred in the autumn, when it passed much nearer the earth, and hence its greater brilliancy.—*Jour. of Franklin Institute, May,* 1840, *p.* 358.

9. *New Comet.*—The third comet of A. D. 1840, was discovered at Berlin, Oct. 26, 1840, by Dr. Bremicker. It was then near *o Draconis*, and appeared as a faint nebula. Its elements, as computed by Mr. Petersen, Assistant Observer at the Altona Observatory, from observations taken Oct. 27, 28 and 31, are as follows:

Passage of Perihelion, 1840, Nov. 15.9154,	m. t. Altona.
Perihelion distance, - - - -	1.44805
Longitude of Perihelion, - - -	25° 17′
" " Ascending Node, - -	248° 31′ 55″
Inclination, - - - - - -	57° 29′ 50″
Motion direct.	

Astr. Nachr. 412, *quoted by S. C. Walker, Esq. in Phil. Nat. Gaz. Dec.* 24, 1840.

10. *Manufacture of Glass for Optical Instruments.*

To the Editors of the American Journal of Science and Arts.

Gentlemen,—Glass is a well known substance, which has been made and used from remote antiquity, and the manufacture, like most others, has been gradually improving; and for common purposes of life, the best flint glass now made, exhibits a transparency and beauty which leaves little to be expected from future improvement. But the present state of the arts and sciences requires the greatest attainable perfection in optical instruments, and their glass lenses should possess not only perfect transparency, but perfect homogeneity, so as to produce the least possible irregularity of refraction and dispersion. The invention of the achromatic object-glass, composed of two or more lenses of different kinds of glass, probably induced the English glass-makers to make experiments to improve the manufacture; but it has since declined, or at least has not improved in proportion to the progress of the other arts in England, and Mr. Dollond acknowledged that he had not, for ten years, been able to procure flint glass fit for a good lens five inches in diameter, while it is well known that the continental artists have made fine object-glasses from ten to fifteen inches in diameter, and that orders are now sent from England to the continent for the largest and finest instruments used in astronomical observations. This apparent decline in one of the most useful arts, induced the Royal Society of London, in the year 1824, to appoint a committee of its members and the members of the Board of Longitude, for the improvement of glass for optical purposes. This committee appointed a sub-committee, consisting of Sir John Herschel, Mr. Dollond, and Dr. Faraday. These gentlemen, most eminent in science, conducted all the experiments, and in the year 1834 reported progress, and that they had succeeded in making glass plates seven inches square and eight tenths of an inch thick, tolerably free from bubbles and striæ. Their glass was a silicated borate of lead, composed of $104\frac{1}{4}$ parts of nitrate of lead, 24 parts of silicated lead, and 42 parts of borax; specific gravity 5.44, refractive index 1.8735, dispersive index 0.0703; and was not free from color. This result does not appear to have been very satisfactory, and I have not heard of any further experiments or results.

This branch of physical science has been comparatively neglected, and it is now necessary to revive it, because other branches require the aid of improved telescopes and microscopes, to explore the immensity of space for unseen material systems, and to examine the minute recesses of matter and its living forms. Our own country will furnish all the materials in abundance for making the finest glass, and our philosophers and chemists may as well acquire honor and distinction in that direction as in any other. May we not, then, with propriety and confidence, appeal to the acknowledged genius and perseverance of our citizens, for a share of their attention to this subject; and in this view of it I beg leave to submit a few desultory remarks, which may possibly invite the attention of those who are much better qualified to suggest the proper course to be pursued; and these remarks must necessarily include much that is well known to chemists and opticians, that I may be clearly understood in the sequel.

Crown glass is composed, essentially, of silex and soda; flint glass of silex, potash, and oxide of lead. The proportions of these components are not very definite, and some other materials are sometimes used in small quantities, for the purpose of promoting the fusion, or correcting the accidental color resulting from the impurity of the materials. Crown glass has a light green color, varying from yellowish to bluish; and as the specific gravity of the different materials is nearly equal, and their affinities considerable, it is generally quite homogeneous, even in large masses; but in consequence of the different specific gravities of the materials of flint glass, or of their weak affinities, or of some other cause, it is difficult to procure any considerable mass of it, with the same density, and consequent refractive and dispersive powers in different parts of it. As this imperfection probably results from the natural constitution of the materials, there is but a faint hope of removing it by the counteracting influence of some other material in addition to those which are generally used. As the two kinds of glass, crown and flint, have each a specific action on the solar light, differing in quality as well as in quantity, their combined action in optical instruments is productive of anomalies and imperfections, which, though somewhat reduced by scientific investigation and experimental analysis, have been but partially obviated.

The solar spectrum produced by a crown glass prism exhibits the various colors occupying certain parts of the whole length of the spectrum. The spectrum produced by a flint glass prism also exhibits the various colors occupying certain parts of its whole length; but the proportions of the different colored spaces are not the same in both spectra; the spaces at the red end of the spectrum produced by the flint glass prism being longer, and at the blue end shorter, than those produced by the crown glass prism; and the colored spaces are said to be irrational. This irrationality is the cause of the greatest imperfection of a telescope well made of the best glass. Sir John Herschel has proposed to give the lenses such curvatures as will unite the colors at the points where the brightest red borders on the orange, and where the brightest blue borders on the green. This arrangement will doubtless produce the best image with the glass now used; but I think it is possible to make two kinds of glass that will have the same proportional specific action on light, as to the several colors, each to each, but different in degree, so that the contrary refractions and dispersions will unite all the colors; and Dr. Blair, of

Edinburgh, has actually obtained this result, by using a certain liquid in place of one of the kinds of glass.

The achromatic object-glass is usually composed of a convex crown glass lens and a concavo-convex flint glass lens, of such curvatures that the crown lens will produce a refraction greater than the flint lens, sufficient to produce a positive focus at the proper point, while the dispersions of the two lenses are equal. These conditions require the refractive power of the flint glass to be considerably greater than that of the crown glass, and the dispersive power of the flint to be still greater in proportion to that of the crown, than the refractive power. This requisite property of flint glass is produced by the oxide of lead, which probably increases the dispersive power, nearly in the duplicate proportion of the quantities added to the other materials.

Having now stated the premises, as far as my limited knowledge extends, I beg leave to submit the following inquiries:

1. If we add a small quantity of lead to the materials of crown glass, so as to answer the purpose of a common crown glass lens of an object-glass, and also add a larger portion of lead to the same materials, so as to answer the purpose of the common *flint* glass lens, will not these two kinds of glass have the same *character*, and produce spectra in which the several colors will be proportional, each to each?

2. If we add a very small quantity of lead to the other materials of flint glass, so as to answer the purpose of the *crown* glass lens, and also add a larger portion of lead to the same materials, so as to answer the purpose of the common flint glass lens, will not these two kinds of flint glass have the same *character*, and produce spectra in which the several colors will be proportional, each to each?

3. Can we use bismuth, or some metal other than lead, in the manufacture of transparent and colorless glass?*

4. As the inflexion of light by angular projections, produces nearly the same dispersion that refraction does, and as the best of our polishing probably leaves the surface of glass rough and uneven, which would be obvious if we could see the ultimate atoms, may not a considerable part of the dispersion be derived from the inflexion by the irregularly situated particles at the surface?

5. As the combination of bismuth with some other metals adds much to their fluidity in the melted state, would not the oxide of bismuth probably add much to the fluidity of glass in the melted state?

* We should presume that oxide of bismuth would give a yellow color to glass, and it is quite doubtful whether we could impart any portion of the fluidity which belongs to the alloys of metallic bismuth to the compounds of its oxide with alkaline and earthy bases.—Eds.

6. If we can render glass very fluid in the melted state, and cast lenses in finely polished moulds, is it not highly probable that the separate particles will arrange themselves by mutual attraction, much more regularly than the grinding and polishing can possibly leave them? and may we not in this way hope to lessen the dispersion, or at least its irregularity?

It is said that the alkalies render glass liable to a slow decomposition. If we could make transparent glass of alumina and bismuth, I have reason to believe that we should obtain great refractive power, very little dispersion, and great fluidity in the melted state, which are important desiderata; but it is highly probable that any combination with alumina would produce an opake enamel. I have not heard of any experiments made for these specific purposes. I have no chemical apparatus, and my circumstances will not permit me to make the necessary experiments; I therefore hope that some of the scientific readers of the Journal of Science, who have leisure and fortune, will feel so far interested in the subject, as to ascertain the facts in relation to these inquiries, as well as such others as experience may suggest, and finally inform us all of the results. A. Bourne.

Chillicothe, Ohio, Dec. 17, 1840.

11. *Parasite of the eggs of the Geometra vernata.*—In Volume xxxviii, (p. 385) of this Journal, was given some account of a species of Platygaster which attacks the eggs of the moth (*Geometra vernata*, Peck,) whose larves have so often devastated our apple trees and elms. At the time that account was communicated, I knew nothing of the metamorphoses of the insect. On the 13th of June last, after this year's brood of canker-worms (as they are popularly called) had passed into the earth, I noticed on the fences several clusters of eggs still unopened. Knowing that many of these very eggs had, during November, 1839, been visited by the parasites above mentioned, I examined them carefully. The one which I first opened, contained a single parasite in the perfect state, and ready to come forth. The insect was evidently glad to be released, and after going through with the usual adjustments, walked away. In each of several other eggs which I opened, I found a single parasite. They were in various stages of development, but most of them so far advanced as to show the features of the perfect insect. Most of the remaining eggs, which I laid aside, were, a few days after, found open. A few weeks later, I observed that nearly all the eggs on the fences, most of which were whole on the 13th of June, were now perforated at the top, doubtless by the parasites eating their way out.

It may therefore be inferred, that one egg only is implanted by the parasite in an egg of the canker-worm moth. The latter egg, which is a rude cylinder, one thirty-fifth of an inch long and one sixtieth of an inch in diameter, supplies sufficient food for the sustenance of the parasitic larve, and sufficient room for its habitation, until it assumes the final state. The perfect insects are evolved in June and July, and live probably until the severe cold of the succeeding winter.

These parasites have been abundant during November and December of this year. It seems probable that nearly all the eggs of the canker-worm moth, which are laid from October to December inclusive, (perhaps a third or a quarter of the whole,) are in this manner destroyed. I saw none of the parasites in the spring. I have not yet satisfied myself whether this species of Platygaster is or is not undescribed. E. C. Herrick.

New Haven, Dec. 28, 1840.

12. *Circular of the Royal Society of Northern Antiquaries;* translated from the French, and communicated by Dr. Jacob Porter, of Plainfield, Mass.—The Society invites its members and all the friends of archeological studies to send them whatever can facilitate their researches, and aid them in illustrating the obscure times of antiquity. The following are the principal things which the Society desires to receive:

1. Communications showing the relations which the ancient Scandinavians or Normans had, in remote times, with the other countries of Europe, and making known the residences or establishments that they had there. They here refer principally to Russia, Germany, the Netherlands, the British Isles, France, and the Iberian Peninsula.

2. Researches illustrating the Asiatic origin of the inhabitants of the North, and especially the conformity of the mythology of the Edda to the mythological systems and religious opinions of the Persians, Hindoos, and other people of Asia.

3. Communications relating to the Ante-Columbian times of America, as well as to the archeology, history, geography and languages of this part of the world.

4. For the public library of the Society: Books in all the sciences and in all branches of literature, ancient and modern, particularly charts and engravings representing ancient monuments or views of remarkable places; journals and reviews containing articles on northern archeology, especially notices and criticisms of works published by this Society.

5. For the museum of northern antiquities: Antiquities resembling those of the north, and suitable for making comparisons, so as to ascertain their use. They desire especially to receive implements of stone or bone belonging to savage nations, to whom the use of metals is but little known. These will be of still greater value, if they can be procured in connection

with the handles of wood or bone, to which the savages fastened them for their use. They are also desirous of receiving patterns of the tools employed in fabricating their arms, with information concerning their manner of using them.

The Society has made arrangements that the books presented to its library shall be accessible not only to the members, but also to all the friends of science, and thus be rendered as extensively useful as possible. In the case of duplicates, one copy of such works as the managing committee may find suited for that purpose, will be sent to the public library of Iceland, founded in 1818.

All communications are to be addressed to Professor Charles C. Rafn, 40 Crown Prince street, Copenhagen.

13. *Level of the Dead Sea.*—We learn that among other travellers lately arrived in London, is Mr. Russegger, who went on account of the Pasha of Egypt to Fazoglo, and to whom we are indebted for a barometrical observation on the remarkable depression of the Red Sea, which he states at upwards of thirteen hundred feet below the Mediterranean. Mr. Isenberg, also from Shoa, has reached London, and brings a very favorable account of the prospects of the mission to Ankóbar, to which place he journeyed in company with M. Krapf.—*London Athenæum, May*, 1840.

14. *Preservation of Timber.*—At a recent sitting of the Academy, M. Boucherie presented a memoir "On the Preservation of Timber, by a method peculiar to himself." That method consists in introducing pyrolignite of iron by absorption into the tissue of the wood, immediately after the fall of the tree, or even while it is yet standing. This simple operation is said to be remarkably efficacious: 1st, in protecting the tree against rot, dry or humid; 2d, in increasing its hardness; 3d, in developing and preserving its flexibility and elasticity; 4th, in preventing the cracks which result from variations of the atmosphere when brought into use; 5th, in reducing its inflammable and combustible characters; and, 6th, in giving it colors and odors at once varied and enduring. M. Boucherie laid before the Academy several specimens prepared by this method, the examination of which was referred to a committee.—*Ibid.*

15. *Preservation of timber long sunken under water.*—"Remarks on the structure of the *Royal George*, and on the condition of the timber and other materials brought up during the operations of Col. Pasley, in 1839," by Mr. Creuze. The *Royal George* was the first ship built on the improved dimensions, recommended in consequence

of an inquiry into the superior sailing qualities of the vessels of war in the French and Spanish services. She was commenced at Woolwich in 1746, launched in 1756, and, after bearing a very high character as a ship of war for twenty six years, was accidentally sunk at Spithead on the 29th of August, 1782. From an examination of the various portions of the wreck recovered by the operations of Colonel Pasley, Mr. Creuze states, that the great agent in the work of destruction, during the fifty seven years since the loss of the *Royal George*, has been "the worm," which has, gradually, by its innumerable perforations on every exposed portion of the wood work, reduced it to such a state as to enable the constant wash of the tides to abrade it layer by layer. The portion of the ship which has been thus removed, is considered to be the whole of the upper part, including the topsides above the line of the middle deck ports. The portions of the recovered timbers which had been buried in the mud were perfectly sound; and Mr. Creuze is of opinion, that the bottom of the ship, which is thus protected, and too deeply inhumed to be affected by the explosions, will last for ages. Some portions of the copper have undergone so little change, that several whole sheets average the same weight per square foot as those now used in the Royal Navy. This state of preservation, Mr. Creuze is of opinion, may be accounted for on the principle applied by Sir Humphry Davy to the protection of the sheathing of ships. The cast iron guns which have been recovered, were so much softened as to be easily abraded by the finger-nail, to the depth of one-sixteenth and one-eighth of an inch; but they gradually hardened on exposure to the atmosphere. The brass guns are as sharp in their ornamental castings, and apparently as sound, as at their first immersion. A piece of two and a half inch cable layed cordage, made from a specimen of tarred rope, possibly part of the ship's old junk for sea store, or of one of the cables used in an attempt to weigh her soon after she sunk, was found to bear 21 cwt., 3 qrs., 7 lbs.; while a similar cable, made from yarn spun in 1830, bore only 20 cwt., 1 qr., 7 lbs. Mr. Creuze then states some peculiarities in the structure of the *Royal George*, and concludes with a descriptive catalogue of a series of specimens which accompanied the paper.—*Ibid.*

16. *New process for making Sulphuric Acid.*—M. Provostaye, of Paris, has proposed the following process: He recommends introducing into the leaden chamber sulphuric acid, nitric acid, and the vapor of water. To understand what takes place under these circumstances, a current of sulphurous acid may be passed into a flask containing nitric acid; this should be made, by means of a bent tube, to

communicate successively with a flask containing sulphuric acid, a globular vessel moistened with water, and a dry globe. The nitric acid is completely decomposed. The first flask contains pure sulphuric acid alone. Red vapors pass from the first vessel into the second; this is filled with sulphurous acid also, for it is formed of solid white crystals, in the two last experiments, as in the first. In the latter, all the sulphuric acid of the second flask exists in a solid crystallized mass, of a greenish yellow color. The re-actions are, therefore, similar to those of the old process. In the new process, the nitric acid yields a portion of its oxygen to the sulphurous acid, in order to convert it into sulphuric acid. Hyponitric acid is thus formed, which acts like the hyponitric acid in the old process, which is formed from the binoxide of azote and oxygen of the atmosphere; that is to say, successively it yields oxygen to the sulphurous acid, and borrows it from the air; but the discharge requires the intervention of sulphuric acid and water. The water has two very distinct functions; it acts directly, by bringing into more intimate contact the sulphurous acid and hyponitric acid, and this favors the oxidation of the first by the oxygen of the second; it acts also by decomposing the white crystals immediately, and changing them into sulphuric acid and oxide of azote.—*London Athenæum, Aug.* 1840.

17. *Oxalic Ether with Chlorine.*—Malaguti has succeeded, by means of the action of heat, (212°,) direct light, and chlorine, in converting oxalic ether into a crystallized substance, in which all the hydrogen has been driven off and replaced by chlorine. Its formula is—C_4O_3, C_8Cl_5O. It is neutral and destitute of taste and smell. It melts at 338°, and congeals in rectangular plates. All fluids which have an affinity for chlorine decompose it, such as alcohol, simple and compound ethers, essential oils, &c. Among the products of the decomposition is an oil corresponding to anhydrous oxalovinic acid, containing chlorine instead of hydrogen. When ammonia is added to this oil, needleform crystals are produced, which are volatile, fusible, neutral, represented by oxamethane, which only contains two atoms of the hydrogen of the amide, the rest being replaced by chlorine—thence it is a compound of one atom of oxamide with one of chloretted oxalic ether.—*Ibid.*

18. *Elaterite, or Fossil Caoutchouc.*—Pelouse has ascertained that this substance, which occurs in La Vendce, has the same composition as Indian Rubber, viz. C_8H_7. In this country it is accompanied by a sort of gum resin, which is sometimes red, sometimes yellow, and even greenish; transparent, insoluble in water, and corresponds in its characters with amber.—*London Athenæum, Aug.* 1840.

19. *Gold in France.*—Becquerel has found a considerable quantity of gold in the sand of Cantal, near Aurillac. The rock in which it occurs is mica slate. The matrix contains lead: 268 lbs. troy contain about 261 grains of gold.—*Ibid.*

20. *Artificial Preparation of Sugar.*—1. Sugar similar to that of grapes may be prepared by boiling one part of the starch of potatoes or flour, with from $\frac{1}{100}$ to $\frac{1}{10}$ of sulphuric acid, and four parts of water, for thirty six or forty hours, care being taken to renew the water as it evaporates. At a higher pressure and temperature, the change may be effected more rapidly with a smaller quantity of acid. The excess of acid is then to be saturated with lime, the sulphate of lime separated, and the liquid concentrated by sufficient evaporation. 2. The starch of flour soon loses its gelatinous consistence, when moistened with an extract of sprouted barley; it is transformed into a liquid, and if the barley is in sufficient quantity it is changed in the course of a few hours into sugar of grapes, provided the temperature be maintained at 158° to 167°. Six parts of barley which has germinated produce twenty five parts of sugar of grapes. 3. Grape sugar may also be prepared from wood sawings; it may also be procured by taking twelve parts of linen rags, or paper cut into small pieces, mixing them intimately and gradually with seventeen parts of concentrated sulphuric acid, or with five parts of sulphuric acid and one part of water: the temperature must be kept moderate. After twenty four hours the mass is to be dissolved in a quantity of water, and boiled for ten hours; it is then to be neutralized with chalk, filtered and evaporated to the consistence of syrup, and crystallized. Chemists have not yet been able to obtain sugar prepared by these artificial methods in regular crystals like cane sugar, although there is little doubt that these two species differ from each other merely in the quantity of water with which they are combined.—*Ibid.*

21. *Action of Alcohol upon Alkalies.*—Dumas and Stass have found that alcohol, when acted on by hydrate of potash and heat, is converted into pure hydrogen and pure acetic acid:—

$C_4H_5O + HO$ alcohol.

$C_4H_3O_3 + HO + H$ acetic acid and hydrogen.

Pyroxylic spirit, under the same circumstances, furnishes formic acid and pure hydrogen. Ethal, by the same reaction, is converted into a new acid—*ethalic acid* and pure hydrogen:—

$C_{32}H_{34}O_2$ ethal.

$C_{32}H_{32}O_4$ ethalic acid.

From these facts it would appear that all kinds of alcohol are converted, by the influence of hydrate of alkalies, into an acid, which is produced by losing four volumes of hydrogen and gaining two volumes of oxygen, conformably to the theory of types and the law of substitutions.—*Ibid.*

22. *Iodine in Coal.*—M. Bussy has recently procured iodine in the form of hydriodate of ammonia, in different specimens of coal from Commentry, (Allier.)—*Ibid.*

23. *Six new species of Kangaroo.*—Mr. Gould, who has just returned from Australia, after an absence of two years and a half spent in the investigation of the habits and economy of the animals of that continent, brought before the notice of the Zoological Society six new species of kangaroo, which he had discovered principally in the interior of that country. The first to which he drew attention was a large species, but inferior in size to the *Macropus major*, discovered on the summits of the mountain ranges. Mr. Gould observed that it was a most powerful animal, and very dangerous to approach. The general color of the male is slate gray, slightly intermixed with brown on the back, and the feet are black; the female is much paler than the male: the fur is somewhat harsh and shaggy. The unusual strength and size of the limbs suggested the specific name *robustus*, which Mr. Gould gave to this animal. The second species of kangaroo has a remarkably elegant appearance; being of a slender, delicate form, and adorned with two white stripes, which, commencing at the occiput, run down the back of the neck on to the shoulders, where they are recurved; the general color of the upper part is gray; of the neck, pale fawn color; and of the under parts, white. Mr. Gould proposed to designate this species by the name *frenatus*. The third species is about the same size as the last, being about two feet in height, and of a yellowish fawn color, becoming whitish about the head; its tail is very long; but the most remarkable character of this animal consists in its having a nail at the tip of the tail; this nail is hidden by the tuft of hair with which the end of the tail is furnished, and greatly resembles a finger nail, both in texture and form, but is of a black color. The name *unguifer* was proposed for this species. In the *M. frenatus* Mr. Gould had found a horny nail at the tip of the tail, but less developed than the last mentioned species. To the fourth species Mr. Gould gave the name *lunatus;* this name being suggested by two crescent-shaped white marks observable on the shoulders of the animal, which is about the size of a rabbit, of a gray color, and has a short head and large ears. The fifth species, Mr. Gould observed, is nearly allied to the *Macropus penecillatus*, but differs, it being rather smaller, in having the tail less bushy, the under parts of the body

of buff color, in wanting the white spot on the chest, and some other characters; two distinct black marks, margined above with white, are observable on the sides of the body. The name *lateralis* was given to this animal, and to the last species Mr. Gould gave the name *psilopus*, on account of the smallness of its fore feet and legs; this animal resembles the common hare in size, and also in the coloring and texture of the fur; so much so, indeed, that a portion of its skin could not be distinguished from that of a hare: its fore legs are black. *Macropus frenatus* was discovered in the interior of New South Wales; *M. unguifer* on the northwest coast; *M. lateralis* and *M. lunatus* on the west coast; and *M. psilopus* in the interior of Australia. Mr. Gould also exhibited a remarkable spring lizard, allied to the Agamus, which he had procured from Swan River. He then called the attention of the members to an extraordinary piece of bird-architecture, which he had ascertained to be constructed by the satin bird, *Ptilonorhynchus holosericeus*, and another, of similar structure, but still larger, by the *Chlamydera maculata*. These constructions, Mr. Gould states, are perfectly anomalous in the architecture of birds, and consist in a collection of pieces of stick and grass formed into a bower; or one of them (that of the *Chlamydera*) might be called an avenue, being about three feet in length, and seven or eight inches broad inside; a transverse section, giving the figure of a horse-shoe, the round part being downwards. They are used by the birds as a playing-house, or "run," as it is termed, and the male birds use them to attract the females. The "run" of the satin bird is much smaller, being less than one foot in length, and moreover differs from that just described, in being decorated with the highly colored feathers of the Parr tribe: the *Chlamydera*, on the other hand, collects around its "run" a quantity of stones, shells, bleached bones, &c.; they are also strewed down the center within. Mr. Gould spent much time in observing the habits of those birds, and was fully satisfied that the runs were actually formed by them, and constructed for the purposes described.—*Ibid.*

24. *Proceedings of the Tenth Meeting of the British Association.*—This meeting was held at Glasgow, in Sept. 1840. Our abstract of its proceedings is unavoidably postponed to the next number.

25. *Necrology.*—At the last anniversary meeting of the Linnæan Society of London, held May 25th, 1840, (the anniversary of the birth of Linnæus,) the President, according to the usual custom, opened the business of the meeting by stating the number of members which the Society had lost by death during the past year, with

short notices of each. We find among the fellows the names of *John, Duke of Bedford*, who was not only a most munificent patron of botanical science, but an author of several splendid works; of *William Cristy, Esq.*, an excellent botanist and universally beloved, who was removed at an early age; of *Allan Cunningham*, the celebrated traveller and botanist, who, after the melancholy death of his brother Richard, was appointed to succeed him as colonial botanist at New South Wales, where he died in about a year after his arrival; *Davies Gilbert, Esq.*, late President of the Royal Society, aged 73; *Rev. Patrick Keith*, the well known physiological botanist, aged 71. Among the foreign members we find the name of *Don Mariano Lagasca*, of Spain, a distinguished botanist, who had spent many years in England, having been obliged to take refuge there at the overthrow of the constitutional government in 1822: also the profound *John Frederick Blumenbach*, so long a celebrated name in anatomy and physiology; he was Professor of Medicine in the University of Göttingen, where he died on the 22d of January last, at the advanced age of 88: also, *Baron Jacquin*, of Vienna, Professor of Botany and Chemistry in the University, and Director of the Botanic Garden of Vienna, which situations he has held for many years, having succeeded his celebrated father; he published the *Eclogæ Plantarum*, in the same style with the large and splendid series of works of the elder Jacquin.

From another source we learn that natural science has recently sustained another severe loss, in the death of *Prof. Meyen*, of Berlin, the distinguished vegetable anatomist. The November number of the Annals of Natural History announces the death of *Prof. Wiegmann*, also of the University of Berlin, a well known zoologist, and the editor of the *Archiv für Naturgeschichte*, in which Prof. Meyen's smaller memoirs have generally appeared. The same journal also announces the decease of *Mr. Vigors*, the distinguished English ornithologist.

Dr. Buckland, in his anniversary address, Feb. 21, 1840, before the Geological Society of London, continues the melancholy catalogue. Mr. *William Smith*, of Scarborough, England, aged 71, after a few days illness, in August, 1839, on his way to the meeting of the British Association at Birmingham. He was justly styled the father of English geology, since to his discoveries we owe the first diffusion of exact knowledge as to the order of superposition of the secondary formations which occupy so large a portion of that island, and the first demonstration of that constancy of the organic remains, which he proved to be characteristic of the component strata of each different formation. It was the especial merit of Mr. William Smith to establish a series of types of these groups, many of which have been adopted as classical, in such a manner as will perpetuate his name among the original discoverers of the age in which he lived. He was born on the oolite formation at Churchill, in the county of Oxford, in 1769. When a child, he was in the habit of collecting terebratulæ from the oolite rocks in the fields of his native village, which he used as substitutes for marbles. He had often expressed a wish to be buried in this formation, on which he was born and educated, and the history of which he had so much elucidated. He was interred in the church-yard of the beautiful Norman church of St. Peter, in Northampton, which stands on the oolite formation.

Sir John St. Aubyn, who died in 1840, was one of the founders and early vice-presidents of the Geological Society.

Brigadier Charles Silvertop, F. G. S., died at Rennes, in June, 1840, on his way to the Pyrenees and Italy. He did much to elucidate the geology of Spain.

Jeus Esmark, Professor of Mineralogy in the University of Christiana, was one of the many disciples of the School of Freyberg, and became deeply imbued with the doctrines of Werner. He published his tour through Hungary, 1 vol. 8vo. 1798; also, 1829, his tour in Norway; also, many detached memoirs on mineralogy. He discovered the chromate of iron in Norway, also the Norwegian datholite in 1806, which was then called Esmarkite.

Frederick Mohs, Professor of Mineralogy in Vienna, was born at Gernrode, in the Hartz mountains, about 1770. He was a pupil of Werner, and succeeded to his chair of mineralogy in the Mining Academy at Freyberg, but in 1826 went to reside at Vienna, as Prof. of Mineralogy and Superintendent of the Imperial Cabinet. In 1804 he published "a detached account illustrated with a ground plan of the mines and mining operations at Himmelsfürst, near Freyberg." His great work on Mineralogy, or the Natural History of the Mineral Kingdom, is best known in this country by its translation, published at Edinburgh, with considerable additions by his pupil, Mr. William Haidinger, in 1825, 3 vols. 8vo. He died in Italy, 20th Sept. 1839, at Agardo, near Belluno, having undertaken a tour into that country for the purpose of studying the phenomena of volcanoes.

Death of Littrow.—Science has suffered a severe loss in the recent death of the celebrated astronomer, Von Littrow, Director of the Observatory and Professor of Astronomy in the University of Vienna.—*Vienna*, Dec. 3, 1840. *N. Y. Jour. of Com.*

Death of Poisson.—M. Poisson, universally known as an eminent mathematician and philosopher, died at Paris, April 25, 1840, aged 58.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Notice of the Botanical Writings of the late C. S. Rafinesque.*

Constantine S. Rafinesque-Schmaltz, a Sicilian by birth, first arrived in this country in the year 1802, where he remained for three years; and returning from his native land in 1815, continued to reside in the United States until his decease in September last, (1840.) The name of this eccentric, but certainly gifted person, has been connected with the natural history of this country for the last thirty-five years; yet, from the manner of their publication, many of his scattered writings are little known to men of science. It is chiefly as a naturalist that Rafinesque is known, although his attention has by no means been restricted to Natural History; since works on Antiquities, Civil History, Philology, Political Economy, Philosophy, and even a poem of nearly six thousand lines, have proceeded from his pen. Botany, however, was his favorite pursuit, and the subject of a large portion of his writings; and to these we purpose to confine ourselves in the present article. Our task, although necessary, as it appears to us, is not altogether pleasing; for while we would do full justice to an author, who, in his early days, was in some respects greatly in advance of the other writers on the botany of this country, and whose labors have been disregarded or undervalued on account of his peculiarities, we are obliged, at the same time, to protest against all of his later and one of his earlier botanical works.

A few years ago, Mr. Rafinesque published his autobiography, entitled, *A Life of Travels and Researches*, (Philadelphia, 1836;)

a characteristic and interesting pamphlet, which is not at present in our possession. An abridged account of his travels and researches in this country, is also given in the introduction to his *New Flora of North America*, which we extract with slight condensation.

"I came to North America in 1802, and travelled chiefly on foot until 1804, over New Jersey, Pennsylvania, Delaware, Maryland, and Virginia, from the Juniata to the sea shore, and from the Alleghany Mountains beyond Easton to the Potomac beyond Washington and Alexándria.——In 1805 I left America for Europe, where I remained till 1815. On my return to this country in that year, I was shipwrecked on the shores of Connecticut, and lost all my former herbals and collections, both American and European.——I had to begin again my researches and collections, which I pursued ever since with renewed zeal, and always at my own sole expense. I spent 1815 and 1816 in the States of New York, New Jersey, and Pennsylvania chiefly. In 1816 I went to explore as far as Lake Champlain, Vermont, and the Saranac Mountains near the sources of the Hudson River. In 1817 I went to the Matteawan or Catskill Mountains, and explored Long Island, where I dwelt awhile. But my great travels in the West began in 1818; I made a tour of 2000 miles, as far as the Wabash River, crossing twice the Alleghany Mountains on foot, and exploring Ohio, Indiana, Illinois, Kentucky, &c.——Having been appointed Professor of Natural Sciences in the University of Lexington, in Kentucky, I went there in 1819, crossing a third time the Alleghany Mountains, through the Cumberland road of Maryland, still on foot, as I never would cross these beautiful mountains in any other way, in order to botanize all the while, and I was rewarded by many new plants. I spent seven years in Kentucky, exploring that State thoroughly, and making excursions to Ohio, &c.: my longest journeys were in 1823, when I went west as far as the rivers Cumberland and Tennessee near their mouths, and next east to the falls of the Cumberland River, and the Wasioto or Cumberland Mountains. In 1825 I undertook a long journey through Ohio and Virginia, crossing the Alleghany Mountains of Virginia, and returning by the Alleghanies of Pennsylvania, always on foot. Next year, 1826, I left Kentucky and settled in Philadelphia; but took a very long botanical journey in the way, going through Ohio to Sandusky on Lake Erie; thence to Buffalo, Niagara, Canada, the New York Canal, &c."

His excursions from 1827 to 1830, were confined to Pennsylvania, New Jersey, New York, Massachusetts, &c.

"Several botanical excursions and journeys were undertaken in 1831, in Delaware, New Jersey, and the Taconick Mountains. While in 1832

I visited Maryland twice; the second time I explored the Cotocton Mountains of Maryland, and the Alleghany Mountains as far as Sherman Valley and the Juniata, quite at leisure, residing sometimes at the top of the mountains. In the year 1833 I proposed to visit the Apalachian Mountains as far as Alabama, but was prevented by an accident and heavy rains. I only went as far as those of Virginia, and again in the Cotocton Mountains. In a second journey I undertook to visit the sources of the Delaware and Susquehannah.——The year 1834 saw me twice in the Alleghany Mountains of the North, once by following the course of the Delaware, the second time westward by the Welsh Mountains, Conewago Mountains, Albany Mountains, Locust Mountains, to the Pottsville mines and sources of the Schuylkill River, returning by Mauchchunk and Allentown. My travels of 1835 were in the central Alleghanies, up the rivers Juniata and Susquehannah, exploring the mountains of Peters, Buffalo, Wisconisco, Mahantango, Tuscarora, Jack, Seven-mountains, &c., with their valleys.——Since then I have chiefly explored South New Jersey and the pine barrens."

He draws a lively picture of the discomforts, as well as the enjoyments of a travelling naturalist.

"During so many years of active and arduous explorations, I have met of course all kinds of adventures, fares and treatment. I have been welcomed under the hospitable roof of friends of knowledge and enterprise, else laughed at as a mad botanist by scornful ignorance.——Such a life of travels and exertions has its pleasures and its pains, its sudden delights and deep joys mixed with dangers, trials, difficulties and troubles. No one could better paint them than myself, who has experienced them all. Let the practical botanist, who wishes like myself to be a pioneer of science, and to increase the knowledge of plants, be fully prepared to meet dangers of all sorts in the wild groves and mountains of America. The mere fatigue of a pedestrian journey is nothing compared to the gloom of solitary forests, when not a human being is met for many miles, and if met he may be mistrusted; when the food and collections must be carried in your pocket or knapsack from day to day; when the fare is not only scanty but sometimes worse; when you must live on corn bread and salt pork, be burned and steamed by a hot sun at noon, or drenched by rain, even with an umbrella in hand, as I always had. Musquitoes and flies will often annoy you or suck your blood if you stop or leave a hurried step. Gnats dance before the eyes, and often fall in unless you shut them; insects creep on you and into your ears. Ants crawl on you whenever you rest on the ground; wasps will assail you like furies if you touch their nests. But ticks, the worst of all, are unavoidable whenever you go among bushes, and stick to you in crowds, filling your skin with pimples and sores. Spiders, gallineps, horse-flies, and other obnoxious insects, will often beset you, or sorely hurt you. Hateful snakes are met, and if poisonous are very dangerous; some do not warn you off like the Rattle-snakes. You meet rough or muddy roads to vex you, and blind paths to perplex you, rocks, mountains and steep ascents. You may often lose your way, and must always have a compass with you as I had. You may be lamed in climbing rocks for plants, or break your limbs by a fall. You must cross and wade through brooks, creeks, rivers and swamps. In deep fords or in swift streams you may lose your footing and be drowned. You may be overtaken by a storm; the trees fall around you, the thunder roars and strikes before you. The winds may annoy you; the fire of heaven or of men sets fire to the grass or forest, and you may be surrounded by it unless you fly for your life."*

Now for the other side of the picture.

"The pleasures of a botanical exploration fully compensate for these miseries and dangers; else no one would be a travelling botanist, nor spend his time and money in vain. Many fair days and fair roads are met with, a clear sky or a bracing breeze inspires delight and ease, you breathe the pure air of the country, every rill and brook offers a draught of limpid fluid. What delight to meet with a spring, after a thirsty walk, or a bowl of cool milk out of the dairy! What sound sleep at night after a long day's walk; what soothing naps at noon under a shaded tree near a purling brook. Every step taken into the fields, groves and hills, appears to afford new enjoyments. Landscapes and plants jointly meet in your sight. Here is an old acquaintance seen again; there a novelty, a rare plant, perhaps a new one, greets your view; you hasten to pluck it, examine it, admire, and put it in your book. Then you walk on thinking what it might be, or may be made by you hereafter. You feel an exultation, you are a conqueror, you have made a conquest over Nature, you are going to add a new object or a page to science.——To these botanical pleasures may be added the anticipation of the future names, places, uses, history, &c. of the plants you discover. For the winter, or season of rest, are reserved the sedentary pleasures of comparing, studying, naming, describing, and publishing."†

The following list comprises, we believe, all the botanical writings of Mr. Rafinesque which appeared previous to his return to this country in 1815. Those which relate to American botany have reference to his discoveries between 1802 and 1805.

1. Prospectus of Mr. Rafinesque Schmaltz's two intended works on North American Botany; the first on the new genera and species of plants discovered by himself; and the second on

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* *New Flora of North America, Part I, Introduction, p.* 11, *et seq.*

† *New Flora, l. c., Part I, p.* 14.

the natural history of the Funguses or Mushroom tribe of America.—Published in the *Medical Repository*, New York, (edited by Dr. Mitchill,) 2d hexade, vol. 2, 1808.

2. Essential generic and specific characters of some new genuses and species of plants observed in the United States of America, in 1803 and 1804. In a communication to Dr. Mitchill, dated Palermo, Sept. 1st, 1807.—Published in the same work and volume.

3. Notice on the medical properties of some North American plants.—Published in the same work and volume, p. 423.

4. Enumeration of the species of *Callitriche*, and the American species of *Potamogeton.*—Published in the same work, A. D. 1811.

5. An essay on the Exotic Plants which have been naturalized and now grow spontaneously in the middle region of the United States.—Published in the work and volume last cited.

6. Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia, &c. Palermo, 1810. 8vo., 20 plates.

7. Précis de decouvertes et travaux somiologiques de Mr. C. S. Rafinesque-Schmaltz, entre 1800 and 1814, &c. Palermo, 1814. —A small pamphlet, 24mo. pp. 55.

8. Principes Fondamentaux de Somiologie, ou les loix de la nomenclature et de la classification des corps organisés. Palermo, 1814.—An 8vo. pamphlet of 50 pages.

9. Chloris Etnensis, o le quattro Florule del M. Etna. In the Natural History of Mt. Etna by Recupero. Catania, 1814.

10. Specchio delli Scienze Enciclopedico di Sicilia. Palermo, 1814.—A periodical, of which two volumes were published. The following botanical articles are stated to be published in the work, (which we have not seen,) viz:—Plan of the natural method of Somiology; Description of 20 new genera of plants; of 15 new species of Sicilian plants; of a new genus of *Conferva;* three new genera of marine plants; and a new genus of *Fungi.*

We do not include the following tracts, which Rafinesque has enumerated among his works, since they have never been published, viz:—*Florula Delawarica*, a Catalogue of plants found in Delaware; and *Florula Columbica*, or a Catalogue of plants found in the District of Columbia; both sent in 1804 to the *Medical and Physical Journal*, edited by Prof. Barton. A Monography of the genus *Bertolonia*, sent to the Linnæan Society of London in 1810; and Monography of the genus *Callitriche*, increased to sixteen species, sent in 1812 to the Linnæan Society.

The two first named articles comprise nearly all that Rafinesque published on North American botany previous to 1815, and consequently anterior to Pursh; and justice to the author perhaps requires that they should be noticed somewhat in detail. He states that his first proposed work, to be entitled *Nova Genera et Species Plantarum Boreali-Americanum*, will comprise, in addition to all the new genera and species discovered since the time of Linnæus, the ten new genera which are indicated in the annexed essay, [No. 2,] and fourteen more which he mentions as follows. [The remarks in brackets are of course our own.]

" *Geanthia* (*colchicoides*,) differs from *Colchicum* merely in the number of the stamens, which are only three in Pennsylvania." [There is little risk in asserting that no such plant exists in the United States. The name again occurs in the list of twenty new genera published in the *Specchio delle Scienze*, &c., which we have not seen.]

" *Micrampelis* (*echinata*,) differs from *Momordica* in the fruit, which is inflated, muricated, 2-3 locular, 2-3 spermous; in Pennsylvania." [We have in vain searched the subsequent works of Rafinesque for any farther notice of this genus. Perhaps the *Echinocystis*, Torr. & Gr. was intended, but the fruit of that plant has four seeds, two in each cell.]

" *Phemeranthus* (*teretifolius*) is very similar to *Talinum*, and is known by some botanists under the name of *Talinum teretifolium*. Penn. and Carol."

" *Merasperma* (*dichotoma, bifurcata, cylindral., &c.*) belongs to the tribe of *Conferva*, is tubular, inarticulated, with the seeds adhering to the interior of the tubes. Pennsylvania, &c." [He elsewhere calls this genus *Mesasperma*.]

" *Heterodon* (*bryoides*,) small moss with peristome eight dentated, dentatures unequal. It grows in the waters of New Jersey."

" *Leptuberia* (*amorpha*,) small crustaceous lichen. Penn."

" *Heptaria* (*erecta, cuneata, &c.*,) very like to the *Tremella*."

" *Catenaria* (*arenaria, vagabunda, concatenata, &c.*,) intermediary between some *Confervæ* and *Fuci*. On the sea shores."

" *Atheropogon* (*apludoides*,) genus of *gramens*, near akin to the *Apludo*. I found it in Pennsylvania; the name is of Willdenow in MSS."

"*Leptopyrum* (*tenellum*,) it belongs to the tribe of *gramens*, and is akin to the Avena. Found in Virginia." [We have met with no subsequent notice of this genus.]

"*Florkea* (*palustris*,) was discovered by Messrs. Marshall and Muhlenberg, in Pennsylvania, and named by Willdenow. Hexandria, Digynia: natural order doubtful."

"*Forrestia* (*thyroides*,) near akin to *Ceanothus*, but tri-gynous; was found by Mr. Forrest in the northern part of the State of New York." [From a brief communication in an earlier volume of the Medical Repository, the third of the same series, 1806, p. 422, which escaped our notice in making the above cited enumeration, the locality of this plant, (Ballston Spring,) and a good description are given, which leaves no doubt that this new genus, the earliest of the long series published by this author, is founded upon *Ceanothus Americanus*.]

"*Hexorima* (*dichotoma*,) is very near to *Uvularia* and *Streptopus;* was found by Mr. Marshall, in the Alleghany Mountains of Pennsylvania." [The close alliance of this genus to *Streptopus* may be inferred from the subsequent reference of *S. roseus* to the same genus. Vid. *Journal de Physique*, 1819, 8. *p.* 262.]

"*Gaissenia* (*verna*,) akin to *Trollius;* was communicated to me by Drs. Muhlenberg and Gaissenheimer, who named it *T. Americanus*. It is found in Pennsylvania."

Then follows a list of genera, which he proposes to establish upon known species. This we introduce entire, on account of the evidence it affords of Mr. Rafinesque's sagacity at that early period. Several of these proposed genera had indeed been long established, two of them even by Linnæus himself; but we have no reason to suppose that Rafinesque was aware of their publication.

"*Adlumia* (*cirrhosa*,) which is the Fumaria fungosa, *Ait.*

Cucularia (bulbosa,) is Fumaria Cucullaria, *Linn.*

Calistachya (alba,) is the Veronica Virginica, *Linn.*

Diarina (festucoides,) from the Festuca diandra, *Michx.*

Kampmania (fraxinifolia,) Zanthoxylum tricarpum, *Michx.*

Negundium (fraxinifolium,) Acer Negundo, *Linn.*

Jacksonia (trifoliata,) Cleome dodecandra, *Linn.*

Cuttera [misprint for *Cutlera*,] (saponaria and ochroleuca,) Gentiana, *Willd.*

Denckea (crinita,) Gentiana crinita, *Willd.*

Persea (macrocarpa,) Laurus persea, *Linn.*

Heteryta (polemonioides,) Polemonium dubium, *Linn.*

Scoria [doubtless misprint for *Hicoria*,] (tomentosa, mucronata, alba, pyriformis, globosa, &c.,) the Hickory.

Vleckia (nepetoides,) the Hyssopus nepetoides, *Linn.*

Chryza (borealis,) Helleborus trifolius, *Linn.*

Platonia (nudiflora,) Verbena nudiflora, *Linn.*, [misprint for *nodiflora.*]

Turpinia (pubescens and glabra,) Rhus aromaticum and suaveolens, *Willd.* and *Michx.*

Umsema [misprint for *Unisema*,] (obtusifolia and mucronata,) Pontederia cordata, *Linn.*

Macrotrys (actæoides,) Actæa racemosa, *Linn.*

Spathyema (fœtida,) Dracontium fœtidum, *Linn.*

Caullinia (hippuroides,) Hippuris Europæus, *V. Michx.*

Achroanthes (unifolia,) Malaxis unifolia, *Michx.*

Kraunhia (frutescens,) Glycine frutescens, *Linn.*

Savia (volubilis,) Glycine monoica, *Linn.*

Apios (tuberosus,) Glycine apios, *Linn.*

Triadenium (purpurascens,) Hypericum Virginicum, *Linn.*

Hingstonia (exaltata,) Siegesbeckia occidentalis, *Linn.*

Gonotheca (helianthoides,) Polymnia Tetragonotheca, *Linn.*

Trachysperma (natans,) Menyanthes trachysperma, *Michx.*"

Nearly all the genera of this list, with the exception of those formed from Gentiana, are admitted by botanists, although mostly under different names.* In the next paragraph, Rafinesque

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* Adlumia, adopted by De Candolle, is doubtless a good genus. Cucularia had been long anticipated by Borkhausen, under the name of *Dielytra* or *Dicentra.* Calistachya, *Raf.* is of later date than *Callistachys* of Ventenat; Leptandra, *Nutt.* is the next in order of publication, but the genus is not considered a good one. Diarina is adopted with a change in the orthography. Kampmania is typical *Zanthoxylum*, that genus having been founded upon the Southern species, as a distinguished botanist has recently informed us. Negundium, or Negundo, was proposed by Mœnch. Jacksonia, Rafinesque changed in 1819 to *Polanisia*, probably on account of the Jacksonia of Brown, 1812, by which General Jackson has lost a genus. The genera founded upon Gentiana, are of no account. Persea was founded by Gærtner. Heteryta is a *Phacelia.* Hicoria, or Hicorius, was ten years later called Carya by Nuttall. Vleckia is the recent *Lophanthus* of Bentham. Chrysa is the *Coptis* of Salisbury. Platonia, (which Rafinesque afterwards changed to *Bertolonia*,) = *Zapania* of Jussieu, &c. = Lippia, *Linn.* Turpinia forms a good genus or section; but the name being pre-occupied, the author changed it to *Lobadium*, and Desvaux to *Schmalzia.* Unisema may be well distinguished from the other species

proposes to rëestablish the genus *Sarotha* "and to compose it of all the *Hypericums*, which have few stamens and an unilocular capsule, ... and to divide the genus *Monotropa* into two, re-establishing the old genus *Hypopythis ;* and *both shall form a separate natural order or tribe*, under the name of *Monotropeous*." Here we have the order or sub-order Monotropeæ, indicated ten years before its publication by Nuttall. In a short list of some species to be distinguished from allied ones of Europe, he proposes *Erythronium angustatum*, for the *E. Dens-canis* of early American authors ; *Trientalis borealis*, for *T. Europæus*, of the same ; *Lysimachia capitellata*, for *L. thyrsiflora*, Michx. ; and *Viburnum edulum* for *V. opulus*, Michx. ; in which cases, except perhaps the first, he has anticipated other botanists. In other instances he has made mistakes ; he proposed *V. lentagoides* for the American *V. Lentago*, forgetting that Linnæus established the species on an exclusively American plant ; and his *Asclepias fragrans* for the American *A. Syriaca* is in the same predicament. The second part of the essay is occupied with *Fungi*, and several new genera are proposed ; upon which we have no observations to offer.

Ten new genera are proposed and characterized in the second essay, which follows the former. 1. *Phyllepidium* (*squarrosum*,) said to be an Amaranthaceous plant, found near Baltimore ; we do not recognize it.—2. *Schultzia* (*obolarioides*,) said to be "very near akin to *Obolaria*," is undoubtedly the plant itself.—3. *Burshia* (*humilis*,) which is *Myriophyllum ambiguum*. The genus is dedicated to Pursh, but the orthography is incorrect.—4. *Diphryllum* (*bifolium*,) is the same as *Listera*, of Brown, and much older ; but in a later memoir the author insists that it is

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of *Pontederia*, but it is the original species of that genus. Macrotys (here written *Macrotrys*,) which afterwards Rafinesque changed, without reason, to *Botrophis*, although still adopted by some good botanists, is too near *Cimicifuga*. Spathyema= *Symplocarpus*, of Salisbury. Achroanthes is long anterior to Nuttall's *Microstylis*. Kraunhia is also anterior to *Wistaria*, or *Thyrsanthus ;* but Rafinesque seems ever after to have overlooked the name ; and in the *Journal de Physique*, he states that he had called it *Savia*, forgetting, probably, that his Savia (posterior to Willdenow's) is the same with Elliott's *Amphicarpæa*. Apios forms the third instance, in this list, in which Rafinesque has proposed new genera upon the same plants and under the same names as Mœnch had done fourteen years before ! Triadenium= *Elodea* of Adanson. Hingstonia=*Verbesina*, Linn. Gonotheca=*Tetragonotheca*, Linn. Trachysperma=*Limnanthemum*, Gmel. 1769.

different from Listera.—5. *Isotria*, and 6. *Odonectis*, are apparently both founded upon *Pogonia verticillata.*—7. *Carpanthus* (*axillaris*,) is said to be a submersed fern, growing in Pennsylvania and New Jersey.—The three remaining genera belong to *Fungi*. Sixty new species are also described, many of which may be identified, and should not be overlooked.—The few notes on the properties of some North American plants, [No. 3,] contain nothing worthy of particular notice.

The plants described in the *Précis des découvertes*, are chiefly Sicilian: there are, however, several new American genera and species of *Algæ* and *Fungi*, and one new phanerogamous genus, viz. *Tussaca*, which is the *Goodyera* of Brown; the latter published, not in the same year with his own, as Rafinesque elsewhere states, but one year previous, viz. in 1813. We have never seen the *Specchio delle Scienze;* but learn from a list given by Rafinesque in an advertisement, that several of the new genera of plants it contains, are republished from the Medical Repository: but here *Psycanthus* and *Triclisperma* first appear, (both founded on *Polygala*, the latter equivalent to *Chamæbuxus*;) also *Crafordia*, which is still a puzzle, and *Bivonea*, which is founded on *Jatropha stimulosa*. The remainder, so far as they are noticed by succeeding botanists, are referred as synonyms to different exotic genera; but of several we find no subsequent mention, either by Rafinesque or others. Among these are *Kinia* and *Wilsonia*, which, being doubtless dedicated, the one to a German collector in this country, who corresponded with Muhlenberg, and the other to the well known ornithologist, were probably founded on plants of the United States.

We have thus noticed, somewhat in detail, the earlier labors of Mr. Rafinesque, in North American botany.* In these, he had certainly shown no little sagacity; and, considering his limited advantages, he must be deemed a botanist of unusual promise for that period, notwithstanding the defects which, increasing in after life, have obscured his real merits, and caused even his early wri-

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* As early as 1808, Rafinesque had commenced the practice, (not uncommon at that day) of changing generic names when they were not conformable to the Linnæan canons, or even when they were too long or too short. Thus *Calinux* was proposed for Pyrularia, *Michx.* (*Hamiltonia*, Willd.,) *Lyonia* for Polygonella, *Michx.*, *Osmodium* for Onosmodium, *Michx.* &c.—Most of the new genera, &c., published in the Medical Repository, were republished by Desvaux, in his *Journal of Botany*, *vol.* 2, 1809.

tings to be in a great measure disregarded. The botany of the United States offered, at that time, a fine field to a botanist acquainted with natural affinities; and Rafinesque was the only person in this country, who had any pretensions to that kind of knowledge. All we can justly say is, that he possessed talents which, properly applied, would have raised him to a high rank in the science, and that he early apprehended the advantages of the natural classification, although he was by no means well grounded in structural and systematic botany. As early as 1814, indeed, he sketched a general classification of organized beings, to which he continued to attach great importance; but there is nothing new in it except the names, the botanical portion being merely an anagram of Jussieu's leading divisions. His fuller developments of this system certainly contain much that is novel, but at the same time very absurd.*

Rafinesque's botanical writings between 1815 and 1818, (from his return to the United States, until the publication of Nuttall's *Genera of North American Plants,*) consist of some reviews of the works of Pursh, Eaton, Bigelow, &c. (some of which appeared early in 1818,) communicated to the *American Monthly Magazine;* one or two small papers describing plants or animals in the same magazine; and the *Florula Ludoviciana,*† upon which we feel compelled to make some animadversions. The history of this singular production is briefly this.

A Mr. Robin, who traveled in Louisiana soon after the commencement of the present century, appended to his book of travels ‡ a popular account of the plants he had observed, under the

* Vide *Flora Telluriana,* 1836, *part* 1*st, p.* 26, *et seq.* We have not seen the "*Analysis of Nature,* 1815," from which the "Table of New Natural Families," a curious mass of nonsense, is said to be substantially taken.

† *Florula Ludoviciana; or a Flora of the State of Louisiana; translated, revised, and improved from the French of C. C. Robin.* By C. S. Rafinesque, &c. &c. New York, 1817, 12mo. pp. 178, (including the supplement.)—Perhaps we should also include among the published works of this period, a "*Florula Missurica, Mandanensis et Oregonensis,*" as a pamphlet under this name is mentioned in a "Chronological Index of the principal Botanical works and discoveries published by C. S. Rafinesque," (Herbarium Rafinesquianum, second part;) but this index comprises several works which we elsewhere learn have never been published, and we suspect the above mentioned work is in the same condition.

‡ *Voyages dans l'interieur de la Louisiane, de la Floride Occidentale, et dans les iles de la Martinique, et de Saint Domingue, pendant les années* 1802—1806, &c. &c.—Paris, 1807, 3 vols. 8vo.

title of *Flore Louisiane.* This account, as Robin informs us, was prepared from notes made on the living plants, and it is evident (although there is no direct statement on the subject,) that he brought no collection of specimens to Europe, excepting a few seeds for the *Jardin des Plantes.* It is written in French; and the characters of the orders and genera are translated from Jussieu, which gives the work an appearance of scientific precision much beyond its just pretensions. Its value of course depends altogether upon Robin's botanical knowledge and his success in referring the plants he notices to their proper orders and genera; and we remark that the work itself affords no evidence of his competency to the task. Indeed, on Rafinesque's own showing, we can place little confidence in Robin's determinations; for, according to the former, he mistook the leaf of a *Sarracenia* for the spathe of an *Arum*, and described a species of *Podophyllum* as a second species of Arum; he took two species of something near *Commelina* for Orchideous plants; described a *Celtis* as an unknown Proteaceous plant, a plant of the Cherry tribe for a true Laurel, a new genus (?) of *Ranunculaceæ* for a Polygonaceous plant, and the common *Ceanothus* for *Polygonum frutescens*; he mistook *Amsonia* and *Dichondra* for species of *Menyanthes*, a new genus (?) of *Scrophularineæ* for a *Polygala*, a *Phlox* for a *Manulea*, a *Justicia* for an *Amethystea*, an *Hydrolea* for an *Apocynum*, a new genus (?) intermediate between *Oxycoccus* and *Vaccinium* for a *Campanula*, and a species of *Eryngium* for a thistle. On the sole authority of the descriptions and determinations of such a botanist, Rafinesque has established thirty new genera and one hundred and ninety-six new species; and professes to reduce all his plants to their proper orders and genera, correcting Robin's mistakes by his own descriptions. It is worth noticing that a large portion of the one hundred and four plants which are referred to old species, are merely enumerated, and scarcely if at all described by Robin; but in almost every instance in which Robin has given a somewhat detailed description, Rafinesque has not been able to recognize the plant, but has considered it a new genus or species. From this fact, one may form a good idea of the value of Robin's account, and of Rafinesque's new genera and species. We do not pretend to say that Robin really made the blunders which Rafinesque charges upon him, (of which the specimens we have given are only some of the most striking;)

for upon the whole, we place quite as much confidence in his determinations as in Rafinesque's corrections. But we do say, that there is no reason for supposing that Robin has been more successful in the instances which Rafinesque has adopted, and upon which his new species of existing genera rest; and we confidently state, that it is impossible, with all the knowledge we now possess of the botany of that region, to recognize one species out of fifty, with tolerable satisfaction, from Robin's descriptions, which must nevertheless have been drawn from the more common plants of Louisiania; and we never heard of the re-discovery of any one of these new genera and species, although many intelligent botanists and diligent collectors reside in, or have since visited that region. The *Flore Louisiane*, in the state Robin left it, could do no harm, and whatever information it contained was quite as available as at present. As *improved* by a botanist who had never been within a thousand miles of Louisiana, and who at that period, could scarcely have seen a dozen Louisianian plants, the only result has been to burthen our botany with a list of nearly two hundred *species semper incognitæ*. There can, we think, be but one opinion as to the consideration which is due to these new genera and species: they must be regarded as fictitious, and unworthy of the slightest notice.*

As the works of Nuttall, Elliott, Barton, and others appeared, Mr. Rafinesque published critical notices of them in the American Monthly Magazine. He soon after collected and condensed these criticisms, and republished them, with some additions, in the *Journal de Physique* for 1819, with the title of *Remarques critiques et synonomiques sur les Ouvrages de MM. Pursh, Nuttall, Elliott*, etc. In these many suggestions of more or less impor-

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* We are constrained, by the length to which this article has extended, to omit a series of extracts we had prepared in fuller confirmation of our remarks.—We are bound to mention the excuse Rafinesque offers for this production. In the *Herbarium Rafinesquianum*, p. 17, he says: "I have been reproached wrongly to have published my Florula Louisiana out of Robin, without specimens; but Gronovius did so with Clayton, and Willdenow with Loureiro. Robin's herbarium may be seen in France as well as Michaux's," *etc.*—The case of Loureiro's Flora Cochin-Chinensis may perhaps be something to the purpose; but every botanist knows, or may easily know, that the assertion is altogether untrue as regards the *Flora Virginica* of Gronovius, who had the specimens as well as the notes of Clayton in his possession. We find no evidence that Robin brought back a single dried specimen to France: he professes to have drawn his descriptions from the living plants.

tance are thrown out, new genera are proposed, and many genera and species reclaimed on the ground of priority in publication. It is indeed a subject of regret, that the courtesy which prevails among the botanists of the present day, (who are careful to adopt the names proposed by those who even suggest a new genus,) was not more usual with us some twenty years ago. Many of Rafinesque's names should have been adopted; some as matter of courtesy, and others in accordance with strict rule. But it must be remembered, that the rule of priority in publication was not then universally recognized among botanists, at least as in present practice, (the prevalence of which is chiefly to be ascribed to the influence of De Candolle ;) the older name being preferred *cæteris paribus*, but not otherwise. It is also true, that many of the scattered papers of Rafinesque were overlooked by those who would have been fully disposed to do justice to his labors, had they been acquainted with them ; and a large portion of the genera proposed in his reviews of *Pursh*, *Nuttall*, *Bigelow*, &c., were founded on their characters of plants which were doubtfully referred to the genera in which they were placed, or were stated to disagree in some particular from the other species. One who, like Rafinesque, followed the easy rule of founding new genera upon all these species, could not fail to make now and then an excellent hit; but as he very seldom knew the plants themselves, he was unable to characterize his proposed genera, or to advance our knowledge respecting them in the slightest degree. In his later publications, this practice is carried to so absurd an extent as entirely to defeat its object.

The *Journal de Physique* for 1819, also contains a memoir entitled *Prodrome des nouveaux genres de plantes observées en* 1817 *et* 1818, *dans l'interieur des Etats-Unis d'Amérique*, which is probably one of Rafinesque's most creditable productions. It comprises fifty genera, founded mostly, but not entirely, upon plants which he had seen, many of which, however, he had previously proposed, under the same or different names. The most favorable specimens are the following, viz. *Nemopanthes*, *Polanisia*, *Lobadium*, *Blephilia*, *Agroseris*, *Stylimnus*, *Ratibida* and *Lepachys* (taken together,) *Cymopterus*, *Marathrum*, *Clintonia*, *Styrandra*, *Peltandra*, *Diarina*, and *Neuroloma*. Nearly half of these are not here proposed for the first time: in some cases he had been anticipated; and in others the names were pre-occupied.* The following have never been identified, viz. *Discovium*, *Leptrina*, *Flexularia*, *Anthipsimus*, and the five acotyledonous genera. In the same year (1819,) he again published three of these genera, viz. *Cylactis*, *Nemopanthes*, and *Polanisia*, in the first volume of the *American Journal of Science*, to which he also contributed several short botanical and zoological, or miscellaneous articles.† His botanical writings between the years 1820 and 1830, inclusive, as far as we can ascertain them, are the following, viz.

Annals of Nature, or an Annual Synopsis of New Genera and Species of Animals, Plants, &c., discovered in North America, 1820. A pamphlet of sixteen pages, printed at Lexington, Kentucky: it is chiefly occupied with zoology; but it contains brief characters of about fifty proposed species of plants, three or four of which are possibly new; but we can only vouch for a single species of the number. The four new genera proposed, are no better than the species.‡

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* The worst are *Cylactis* (which is a Rubus,) *Cyphorima* (Lithospermum,) *Endiplus?* (Phacelia,) *Dacistoma* (Gerardia,) *Dasanthera* (founded on the figure and description of Pursh's *Gerardia fruticosa*=Pentstemon,) *Neurosperma* (Momordica,) *Delostylis* (Trillium,) *Critesion* (Hordeum,) *Trisiola* (Uniola,) *Torreya* and *Distymus* (Cyperus,) *Aplostemon* (=Scirpus cæspitosus and S. triqueter !) under which two additional genera are proposed, viz. *Diplarinus* for the *Scirpi* with two stamens, and *Dichismus* for those with two stigmas.

† One of these articles is devoted a consideration of the natural affinities of *Flœrkea;* which he considers as forming a small family along with *Galenia!!* while *Nectris*, to which Pursh united it, is said to stand next to *Myriophyllum!*

‡ *Ilysanthes* is probably Lindernia, incorrectly described. *Peramibus* is founded on a genuine Rudbeckia. *Hedychloe* is Kyllingia pumila. The characters of the two following genera we copy entire, for the edification of cryptogamic botanists: the first is said to be a Fungus, the second an Alga.

" *N. G.* Anastomaria.—Fructification in flexuose lamellar veins, anastomosed like a net.—This genus will be next to *Merulius* and *Dedalea;* some species of them may probably belong to it.—*A. campanulata.* Stipitated fulvous; stipe thick; pericle campanulated; netted outside, margin erose, insides scaly and dark spotted. —This may be the type of the genus. Size, four or five inches. It grows in the State of New York.—*A. dimidiata.* Sessile, dimidiated, imbricated, wrinkled above and fulvous with brown or black zones, netted beneath; veins often bifid near the margin.—Near Catskill, State of New York. It may be the type of a subgenus, *Campsilicus.*

" *N. G.* Stypnion. A floating gelatinous and floccose mass, easily divided and homogeneous, without any perceptible filaments or organs.—A very singular genus, next to my *G. Potarcus.* It differs from *Conferva*, which consists of five fixed filaments, and *Oscillatoria* of interwoven articulated ones. I could not perceive any filaments in it, perhaps a microscope might show some [! !] surrounded by a jelly. The name means *tow* in Greek.—*S. fluitans.* Floating, elongated perpendicularly; amorphous, floccose or lacerated; of a dirty yellowish or brown color.—Very com-

Tracts in the Western Review, about the year 1820. Among them is a *Monograph of North American Roses;* in which thirty-three species indigenous to the United States are described! Also a *Monograph of Houstonia*, in which fourteen species are described, exclusive of the Hedyotis crassifolia of his Florula Ludoviciana, of which he forms a new genus! These tracts, with another on the classification of some natural families, have been reprinted in the fifth, sixth, and seventh volumes of the *Annales Générales des Sciences Physiques*, at Brussels.—The following are unknown to us.

1821. "*Western Minerva;* several new genera; suppressed by my rivals!"

1822. "*The Cosmonist*, twenty numbers, Lexington.—New Plants of Kentucky."

1823. "*Prenanthes Opicrina*, and other plants, Cincinnati."

1824. "*Florula Kentuckensis* and Prodromus N. sp., Lexington." No intimation is given of the place or form of publication.

1824. *First Catalogues and Circulars of the Botanic Garden of Transylvania University*, Kentucky.

1825. *Neogenyton*, or indication of sixty-six new genera of plants of North America.—A loose sheet of four pages, printed at Lexington; and we believe reprinted in Seringe's *Bulletin.* A few good genera are indicated in this tract, but not properly characterized. The best are, *Cladrastis* (Virgilia lutea; upon which he endeavors to establish three or four species,) and *Stylipus.* A few are good, but anticipated by other authors; such as *Helichroa* (in which some seven or eight species are made out of at most three,) which is *Echinacea* of Mœnch; and *Megadenus*, which is *Eleocharis* of Brown; several others may be found to indicate sections or sub-genera; but about fifty of the sixty-six are absolute nonsense.*

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mon on the surface of the Ohio in summer, having the appearance of pieces of ropes or oakum. It smells like *Conferva.*" *Rafinesque, l. c. p.* 16.

* Thus, *Tomostigma* is founded upon Draba Caroliniana; *Hartiana*, upon Anemone Caroliniana, &c.; *Stylisma*, on Convolvulus tenellus, is said not to belong to the *Convolvulaceæ*; *Helepta*, with three species, is made from Heliopsis lævis; *Endodia* and *Aplexia* are founded, one on Leersia lenticularis, the other on L. Virginica; three genera are founded upon genuine species of Croton, and one on Stillingia sylvatica, &c. &c. It is but fair to notice, however, that it appears from the species cited, that his *Ptilemnium* is the same with Discopleura, *DC.*, his *Spermolepis* with Leptocaulis, *Nutt.*, and his *Oxypolis* with Archemora, *DC.*, but mixed with an Angelica and Tiedmannia. None of them could have been identified by the characters assigned.

A pamphlet (?) entitled "*Neocloris or New Species of Western America*," is mentioned by Rafinesque, but neither the place nor form of publication are given: we are wholly unacquainted with it.

1826. "*School of Flora*, with figures, Philadelphia."

1828. "*Neophyton Botanicon*, or New Plants of North America."—*Medical Flora of the United States*, vol. 1, 12mo. Philadelphia. The second volume was published in 1830. It is illustrated with rather rude wood cuts, and contains much information respecting the plants employed in popular medicine.

1830. *American Manual of the Grape Vines, and the Art of Making Wine.* Philadelphia: a pamphlet of sixty-four pages, 12mo.—He describes sixty-two species of grape, of which forty are natives of the United States! One hundred varieties of our species are characterized!—"*Botanical Letters to De Candolle.*"

A gradual deterioration will be observed in Rafinesque's botanical writings from 1819* to about 1830, when the passion for establishing new genera and species, appears to have become a complete *monomania*. This is the most charitable supposition we can entertain, and is confirmed by the opinions of those who knew him best. Hitherto we have been particular in the enumeration of his scattered productions, in order to facilitate the labors of those who may be disposed to search through bushels of chaff for the grain or two of wheat they perchance contain. What consideration they may deserve, let succeeding botanists determine; but we cannot hesitate to assert that none whatever is due to his subsequent works. These, like many of the preceding, are little known; but we shall continue our enumeration, and future writers can correct our opinion wherever they think we have done the author injustice.

1832. "*The American Florist:* thirty-six figures, 12mo. Philadelphia." With this we are unacquainted.—*Atlantic Journal, and Friend of Knowledge.* A periodical of which eight

* It was in this year (1819) that I became alarmed by a flood of communications, announcing new discoveries by C. S. Rafinesque, and being warned, both at home and abroad, against his claims, I returned him a large bundle of memoirs, prepared with his beautiful and exact chirography, and in the neatest form of scientific papers. This will account for the early disappearance of his communications from this Journal. The step was painful, but necessary; for, if there had been no other difficulty, he alone would have filled the Journal, had he been permitted to proceed.—Sen. Editor.

numbers appeared in 1832 and 1833; published at Philadelphia. The whole forms an 8vo. volume of 212 pages. Its contents are miscellaneous, but there are several botanical articles, in which, of course, new genera and species are described. In one of these articles, Rafinesque takes up Dr. Torrey's account of the plants collected by Dr. James, in Long's expedition to the Rocky Mountains, (published in the second volume of the Annals of the Lyceum of Natural History, New York,) upon which he creates twenty new genera! In another, he describes two new genera of *Umbelliferæ* called *Streblanthus* and *Orimaria*; one of which is an *Eryngium* falsely characterized; the other, a *Bupleurum* (which had doubtless escaped from some garden) in an undeveloped state, which we happen to know Rafinesque had mistaken for a grass, and described as a new genus of that family; but, being told it was a Bupleurum, he has accordingly published it as a new genus "near to Bupleurum."

1833. *Herbarium Rafinesquianum.* Loose sheets, printed in 24mo., we believe at different times, and reaching to about eighty pages. The first part is chiefly a reprint from the last number of his Atlantic Journal; the second contains a list of his botanical works, and account of plants offered for sale, a monograph of *Samolus* increased to ten species, of the American species of *Cypripedium* increased to ten species, of *Spiranthes*, ten species, and of *Jeffersonia* and *Podophyllum*, each increased to four species. The remainder is of the same character.

1836. *Flora Telluriana*: four parts; each of about one hundred pages, 8vo.; the fourth part, or supplement published in 1838.—*New Flora and Botany of North America; being a supplemental flora to the various botanical works of Michaux, Muhlenberg, Pursh, &c. &c. &c.* Philadelphia: printed for the author and publisher. Four parts are mentioned; but we have seen only three, of about one hundred pages each.

The object proposed in the *Flora Telluriana* is general generic reform; and the author informs his readers, that "although the attempt may astonish or perplex some timid botanists," he intends to establish about *one thousand totally new genera*, including some of those he had formerly published:* it is needless to add, that in this and the *New Flora of North America*, together, he has nearly fulfilled his promise. According to his principles,

* *Flora Telluriana*, Introduction, p. 15.

this business of establishing new genera and species will be endless; for he insists, in his later works particularly, that both new species and new genera are continually produced by the deviation of existing forms, which at length give rise to new species, if the foliage only is changed, and new genera when the floral organs are affected. He assumes thirty to one hundred years as the average time required for the production of a new species, and five hundred to one thousand years for a new genus; and on a preceding page he remarks,* that "new varieties and species were often met with by me at long intervals, in wild places well explored before, grown from seeds of akin species." "It is even possible," he continues, "to ascertain the relative ages and affinities of actual species and genera. . . . . As a general rule, the real genera of single or few species, are the newest in order of time, and the most prolific, the eldest in the series."†

It is therefore of little consequence, that half his genera and species do not really exist at present, since they may perchance make their appearance a century hence.‡ Our notice of these extraordinary works must be very brief. The first and most amusing part of the *Flora Telluriana*, is chiefly occupied with the author's views of natural classification, upon which we have already made some remarks. This is followed by "The fifty rules of generic nomenclature, by *Linnæus and Rafinesque!*" In the second, the business of making genera is begun in earnest, and continued through the work. Thus *Allium* is divided into fifteen genera; Solidago, into seven, with about twice as many sub-genera; *Saxifraga*, into twelve genera, which are placed in three natural orders, and two different classes; *Polygonum* into twenty-three; *Gentiana*, (as left by Grisebach,) into fourteen; *Linum*, into thirty-four; *Hypericum* into eleven; and *Salvia*, into fourteen genera absolutely, and fourteen more proposed as doubtful or perhaps sub-genera. "As I have not yet heard of a genus dedi-

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* *Op. cit. p.* 12.—Vid. also *New Flora, &c. p.* 16. † *Op. cit. p.* 14.

‡ "Thus it is needless to dispute and differ about new genera, species and varieties. Every variety is a deviation which becomes a species as soon as it is permanent by reproduction. Deviations in essential organs may thus gradually become new genera. Yet every deviation in form, ought to have a peculiar name, and it is better to have only a generic and specific name for it, than four when deemed a variety." *Rafinesque, in Atlantic Journal, p.* 164. "All our actual species of Roses, Grapes, Oaks, Plums, Apples, Currants, Asters, Azaleas, Heaths, &c., have thus been formed. Nay, it is so probably with every genuine genus of many species." *Herbar. Rafin. p.* 15.

cated to me," he remarks in the introduction, "I shall perhaps have to imitate Roxburgh, and choose one for myself, as a *Rafinesquia.*" It is not true that Roxburgh dedicated a genus to himself. This honor was reserved for Rafinesque, who accordingly appropriated the *Lotus pinnatus* of the Botanical Magazine, and described it in due form as RAFINESQUIA seu *Flundula*, the second name being proposed as a substitute in case this honor had been already conferred by some other person. But as the plant turned out to be an *Hosackia*, he is obliged to make another trial; and in the preamble to the third part, he continues: "As to a *Rafinesquia*, I have provided half a dozen, out of which I hope some one will suit the fancy of botanists and be adopted; although I may be blamed for this conceit, I blame instead for it those makers of new genera, that dedicate them to obscure individuals, that have not added one page to the science; and have not thought of me for forty years, who have added one thousand pages to it, and three thousand new genera or species."* His next choice falls upon the beautiful *Gardoquia Hookeri!* which is published in due form as the second RAFINESQUIA of *Rafinesque*;† and of which he makes two species in his New Flora of North America.

The last named work is precisely of the same character with the preceding, except that the new genera are not quite so numerous, but the new species amply supply the deficiency. Several of the former are made in this way: "Actimeris, *Raf.*, misspelt *Actinomeris* by Nuttall; *Actispermum*, Raf., misspelt *Actinospermum* by Elliott." As to species, the following may suffice for examples. A single *Amphicarpœa* is divided into ten species in two genera, *Bellis integrifolia* into four species, *Capsella Bursa-pastoris* into seven species and one new genus besides, *Prunella vulgaris* into ten species, two species of *Triosteum* into eight, a single (?) *Eclipta* into ten or twelve species and apparently three genera, &c. &c. These are by no means unusual instances, but fairly exhibit the character of the work.

1839. *American Manual of the Mulberry Trees.* Philadelphia. Of this pamphlet we have seen no more than the title-page and the first sheet.

1840. *The Good Book and Amenities of Nature; or Annals of Historical and Natural Sciences*, is the last we have to notice.

* *Flora Telluriana, part* 3, *p.* 6. † *Op. cit. part* 3, *p.* 82.

We have only seen a few sheets of this miscellaneous work, which purports to be the commencement of a periodical or occasional publication. The first article is a general classification of the sciences comprised in "*Cosmosy*, or Natural History." Here we meet with such names as the following branches of *Astrography*, viz. "*Astrosy*, *Heliosy*, *Tholosy*, *Selenosy*, *Cometosy*, *Toxosy*, &c., applying to the stars, the sun, the planets, the moons, the comets, and the various *Tixomes* (other bodies) of the skies;" as well as "*Atmology*, the science of the atmosphere," with its branches, such as "*Yetology*, of rains; *Phosology*, of luminous meteors;" not to mention *Dimnology*, *Potamology*, *Stromology*, *Spilology*, *Volcanology*, *Stocology*, *Etherology*, *Gazology*, *Gazomy*, *Uxromy*, *Flogomy*, "the flogomes, or burning substances," *Campsology*, &c., &c., &c. This reminds us of a paper which Rafinesque many years ago sent to the editor of a well known scientific journal, describing and characterizing, in natural history style, *twelve new species of thunder and lightning!* But the only botanical article we have seen is a "*Revision of the Carexides*," in which the simple genus *Carex* is divided into two sub-families and eighteen genera: and we observe that the same species, under different names, are frequently cited as the types of two or three different genera. With this, so far as we can ascertain, the last botanical article of this indefatigable writer, we close our remarks, which many readers will probably consider unreasonably prolix.* A. G.

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* Mr. Rafinesque's papers on Zoology, Fossil Remains, &c. are numerous; but we are not prepared to enumerate them. The following are some of his more considerable miscellaneous works, exclusive of those previously mentioned, viz.

The American Nations; or outlines of their general history, ancient and modern, including the whole history of the earth and mankind in the western hemisphere, &c. &c. Vol. I. Philadelphia, (published by the author,) 1836. 8vo. pp. 560. Vol. II, is also said to be published.

Safe Banking; including the principles of wealth. Philadelphia, 1837. 12mo. pp. 136.

Celestial Wonders and Philosophy of the Visible Heavens. 1839.

Genius and Spirit of the Hebrew Bible, &c.

The World, or Instability; a Poem in twenty parts: with notes and illustrations. Philadelphia, (J. Dobson,) 1836. 8vo. pp. 248.

Art. II.—*Abstract of a Letter to Baron A. Humboldt, upon the Invention of the Mariner's Compass.*—Lettre à M. le Baron A. de Humboldt, sur l'Invention de la Boussole ; par M. J. Klaproth. Paris : 1834. pp. 138.

Read before the Connecticut Academy of Arts and Sciences, by Edward E. Salisbury, A. M., and published by permission of the Academy.

This is the title of a little volume, published six years ago, in which M. Klaproth, a well known orientalist, since deceased,* has given the result of researches made by him, respecting the invention of the mariner's compass.

It has been long since generally admitted, that the classic writers, though they had some idea of the attracting and repelling power of the magnet, were ignorant of its polarity, and consequently of its applicability to navigation. But the later opinion, that the merit of this discovery is to be attributed to an Italian of the middle age, must be also abandoned. Klaproth's investigations go to prove, that our knowledge of the magnet, as well as of the magnetic needle and compass, has been derived, either directly or indirectly, from the East, and originally from China, where the earliest notices of both belong.

Should this work not have become known already in this country, a brief abstract of its most important points may not be unentertaining or without value.

The name *magnet* comes from the Greek. The most ancient Greek name for this natural production was λίθος ἡρακλεῖα, *stone of Heraclea*, a city situated at the foot of Mt. Sipylus, in Lydia. This city was afterwards called Magnesia, and the name of the stone, for which it was remarkable, became changed to Μάγνησιος λίθος, *stone of Magnesia*, or vulgarly, Μάγνης, and Μάγνητῆς. The same name is found in the Latin, and its origin from the Greek is confirmed by Lucretius, who says

> "Quem magneta vocant patrio de nomine Graii :
> Magnetem, quia sit patriis in montibus ortus."

Other languages into which the name *magnet* has been incorporated, are the modern Greek, (Μάγνητῆς,) the German, (*magnet*,) the Hollandish, (*magneet-stein*,) the Danish, (*magneet*,) the Swedish, (*magnet*,) the language of the Grisons, in the dialect of

* M. Klaproth was a Prussian, born at Berlin in 1783, and died at Paris in 1835.

Surselva, (*magnêt*,) the Hungarian, (*magnet-kö*,) the Russian, (*magnët*,) the Polish, (*magnes*, *magnet*, and *magnet kamien*,) and the Vendish of Styria, (*magnet*,) where, excepting in the modern Greek, the Latin has unquestionably been the medium of transporting the word from the ancient Greek.

Another name in use in several European idioms, as in the Greek, Italian, French, the Romançe language of Surset, the Bosnian, Croatian, and the Vendish of Styria, is *calamita.* This word appears to be of Greek origin, and is given by Pliny as the name of a *small green frog*. The application of the term to the magnet is explained by a fancied resemblance to that animal in the magnetic needle, when poised on water by means of small reeds, projecting beneath it like the legs of a frog in motion, according to the usual mode in early times, in Europe, of adapting it to the mariner's use. But that the idea of such a resemblance was not original in Europe, one might be led to suspect, from the analogy of the Birman name for the compass *anghmyaoung*, which signifies *lizard*, and will be rendered still more probable by evidence, hereafter to be given, that this mode of using the magnetic needle in navigation, was adopted in China about eighty years previous to the earliest mention of the needle itself in any European writer.

Many of the terms applied to the magnet, both in European and Asiatic languages, allude to one or another of its characteristic properties. Among these, the French *l'aimant*, *the lover*, and the Spanish and Portuguese *iman*, with the same signification, is particularly worthy of notice, as having its precise correspondent in the Chinese *thsu chy*, of which a celebrated Chinese naturalist who flourished in 1580, observes: "if this stone had not a love for the iron, it would not make it come to it," and a writer of an age eight centuries earlier: "The magnet draws the iron like a tender mother, who causes her children to come to her, and it is for this reason, that it has received its name." In India also, the magnet was of old personified as capable of tender attachment, in the Sanscrit name *thoumbaka*, *the kisser*, from which are derived several appellations now in use in that country, as *tchoumbok* in the Bengalee, and *tchambak* in the Hindostanee. Another Sanscrit term for the magnet is *ayaskânta*, *the loved stone*, or *ayaskânta-mani*, *the stone loved by iron*, which also the Bengalee retains; and in the Cingalese the magnet bears the name of *kândakô-galah*, *the stone that loves*, which is apparently composed of the Sanscrit *kânta*, *loving*, and the Cingalese *galah*, *stone.*

The languages of Mussulman Asia derive the names which they give to the magnet, mostly, from the Greek Μάγνητῆς: thus in Arabic we find *al-mâghnâthîs;* in Persian *seng-i-maghnâthîs —the stone maghnâthîs;* and in Turkish *miknâthîs.*

Of the names given to the magnetic needle and compass, one which is to be met with in many European languages, is the Italian *boussola*, the Portuguese *bussola*, the Spanish *brujula*, the French *boussole*, &c. Some Italian authors have claimed this term as original in their own language, and have sought to argue, from its having been so widely adopted in other languages, in favor of their national assumption of the honor of having invented the compass. The word cannot, however, be deduced from an Italian origin any more reasonably than from an assumed English diminutive *boxel*, no such diminutive existing, which some writers have attempted; nor does the Greek Μπέσελας, bear the appearance of being original with that language. The derivation of both the Greek Μπέσελας, and the Italian *boussola*, and so of the corresponding words in other languages of Europe, is to be found in the Arabic *mouassala—arrow*, an initial *m* of Arabic words, having been very commonly changed, in the middle age, to *b*. *Mouassala* is itself one of the names given to the magnetic needle in Arabic.

Among the Turks and Persians, the term for the compass, in most general use, is *kibléh-naméh*, or *kibléh-numa—indicator of the kibléh*, which is the direction to be faced in prayer, and consequently, as Mecca lies to the south of most of the Mohammedan countries, *the south.* With this is perfectly synonymous the Chinese apellation *tchi nan—indicator of the south*, and the Mandchow *dchoulesi dchorikoû*, for the magnetic needle. The Persians undoubtedly derived their name for the compass, *kibléh-naméh*, from the Chinese, for it is a peculiarity limited to the Chinese and those who have adopted their civilization, that they make the south their principal pole, regarding this as the anterior and the north as the posterior side of the world; according to which they also place the throne of their Emperor, and the principal façade of their edifices, so as to front the south.

As the Hindoos have never been addicted to navigation, the knowledge of the compass seems to have been introduced but very late among them, and the names they give to it are for the most part foreign. In the English provinces of India it is called *compass*, from the English; and in the Cingalese of Ceylon, *kompâsouwa*, a corruption of *compass.* The Hindostanee has adopted the Persian term *kibléh-numa—indicator of the south.*

In these comparisons of the most current terms for the magnet and the magnetic needle and compass, in the eastern and western world, there is not a little to lead one to believe that the discovery of the wonderful properties of the magnet originated in the remote Orient, and was gradually communicated to the nations of the west. But there are historic notices of the magnetic needle and compass, which also point to the east as the field of the first discovery of the polarity of the magnet and its applicability to navigation.

The earliest explicit mention of the magnetic needle, by any European writer, is in a poetical work of Guyot de Provins, dating about the year 1190. The next as to date is found in the *Historia Orientalis* of Jacques de Vitry, referring to the year 1204: "Adamas in Indiâ reperitur—ferrum occultâ quâdam naturâ ad se trahit. Acus ferrea, postquam adamantem contigerit, ad stellam septentrionalem, quae velut axis fermamenti, aliis vergentibus, non movetur, semper convertitur, unde valdé necessarius est navigantibus in mari." It would be difficult to give any authority to this passage, and not recognize the east as the source of knowledge, among Europeans, of the polarity of the magnet. Not long before the year 1260, Brunetto Latini, "maître du divin Dante," being on a journey in England, saw the magnet and the magnetic needle for the first time, in visiting Roger Bacon, and a fragment of a letter of his, written on the occasion, which has been preserved, describes them thus: "He shew me the magnet, a disagreeably looking black stone it readily unites with iron; a small needle is taken into the hand and fastened in a bit of reed, then it is put upon a surface of water, and one stands over it, and the point turns towards the star, (the polar star;) in case the night is obscure, and neither star nor moon is seen, the mariner may keep to his right course."

Albertus Magnus, of Swabia, who flourished about the middle of the thirteenth century, quotes in a work of his, "*De Mineralibus,*" a passage from a "treatise concerning stones," attributed to Aristotle, of which the following portion merits particular attention: "Angulus magnetis cujusdam est, cujus virtus apprehendi ferrum est ad *zoron*, hoc est septentrionalem, et hoc utuntur nautæ. Angulus verò alius magnetis illi oppositus trahit ad *aphron*, id est meridionalem: et si approximes ferrum versus angulum zoron, convertit se ferrum ad zoron, et si ad oppositum angulum approximes, convertit se directè ad aphron." Vincent de Beauvais, a cotemporary of Albertus Magnus, has left a similar passage, likewise quoting Aristotle, in his "*Speculum Naturale*:" "Angulus quidem ejus cui virtus est attrahendi ferrum, est ad *zaron*, i. e. septentrionalem, angulus autem oppositus, ad *aphron*, i. e. meridiem. Itaque proprietatem habet magnes, quod si approximes ei ferrum ad angulum ipsius qui zaron, i. e. septentrionem respicit, ad septentrionem se convertit, si verò ad angulum oppositum ferrum admoveris, ad aphron, i. e. meridiem se movebit." The names given in these two passages to the north and south pole, *zoron* or *zaron*, and *aphron*, are the Arabic ظهر—*north*, and أور—*south*. As to the work here attributed to Aristotle, under the title of a "treatise concerning stones," we have no such Greek text of this author, and it is doubtful if ever he wrote such a book. There is an Arabic treatise entitled كتاب الاحجار—*the Book of Stones*, composed by a certain Lucas, son of Serapion, but purporting to be a translation from Aristotle, which Baron De Sacy has shown to be the true source of citations under the name of Aristotle, in the writings of Tëifachi and Bëilak Kibdjaki; and very probably Albert and Vincent have quoted this same work in their account of the polarity of the magnet. However, the names *zoron* and *aphron*, applied by these authors to the two magnetic poles, are sufficient to prove that they derived their knowledge of the magnet's polarity from an oriental source.

But there is no evidence that the Arabs were the inventors of the magnetic needle. It may, indeed, have been in use among the Arabian navigators, before it was noticed by men of science; but we have in no Arabic work any mention of it which goes back beyond the year 1242. In this year, Bëilak Kibdjaki made a voyage from Tripoli to Alexandria, and in his treatise entitled كتاب كنز التجار فى معرفة الاحجار—*the Treasure of Merchants, touching the knowledge of stones*, he has recorded his observations on that occasion, respecting the magnetic needle. "As to the properties of the magnetic needle," he writes, "it is to be observed, that the captains who navigate the sea of Syria, when the night is so obscure that they can see no star by which to steer their course according to the four cardinal points, place a pitcher full of water in the interior of the vessel, to be sheltered from the wind, and then take a needle and pass it through a piece of wood or reed, forming a cross, which they throw into the water in the pitcher prepared for the purpose, and it floats. They then take a magnet large enough to fill the palm of the hand, or smaller, and bring it near the surface of the water, giving their hands a rotatory movement towards the right, so that the needle turns about on the surface of the water. Then they withdraw their hands all of a sudden, and truly the needle points north and south. I myself saw this done on my voyage from Tripoli in Syria to Alexandria, in the year 640," (or 1242 of our era.) "They say," he continues, "that the captains who navigate the Indian ocean supply the needle and piece of wood by a sort of fish, of thin iron, hollow, and so made with them, that, when thrown into the water it floats, and shows by its head and tail the two points of north and south." So early, then, as the year 1242, the water-compass was in general use on the Syrian waters, and was known, it is to be presumed, as well to Arabian as to European navigators. But what this author, Bëilak, says of the peculiar form, according to report, of the magnetic needle which was used in the Indian ocean, indicates an independent knowledge of it in that quarter of the globe; and recalling the signification of *calamita, little green frog*, and the Burman appellation for the compass, meaning *lizard*, leads one to look further to the east than any of the Mohammedan countries for the original discovery of the polaric properties of the magnet. We shall presently see that between 1111 and 1117, the Chinese made a water-compass exactly such as Bëilak describes that which he saw in 1242, in the Syrian waters, and also like that which Jacques de Vitry saw within the first half of the thirteenth century, in the possession of Roger Bacon.

The Chinese have been acquainted with the magnet and its attractive force and polarity from the highest antiquity. In a Chinese dictionary, composed in 121, by Hiu-tchin, the magnet is mentioned, as a "stone with which one can give direction to the needle." About a hundred years later, as we learn from P. Gaubil, in his history of the dynasty of the Thâng, there is found a distinct notice of the compass as an instrument by which to ascertain the points of north and south. Under the dynasty of the Tsin, (i. e. between 265 and 419,) Chinese vessels were already steered to the south by means of the magnet. But the Chinese were acquainted with the declination of the needle, also, a long while before it was supposed to be first discovered by Columbus. In a medical natural history, composed between the years 1111 and 1117, the author gives the following notice of the magnet and of its properties. This is the most ancient *description* of the magnet found as yet in any Chinese book: "The magnet is covered over with little bristles slightly red, and its superficies is rough. It attracts iron, and unites itself with it; and for this reason it is commonly called 'the stone which licks up iron.' When an iron point is rubbed upon the magnet, it acquires the property of pointing to the south; yet it always declines eastward, and is not perfectly true to the south. On this account, a thread of new cotton is taken and attached by a particle of wax as large as a mustard-seed, exactly to the middle of the iron, which is thus suspended in some place where there is no wind. The needle then points, without variation, to the south. If the needle is passed through a little tube of thin reed, which is afterwards placed on water, it directs to the south, but always with a declination to the point *ping*, that is to say, east $\frac{5}{6}$ south." The accuracy of this observation, referring it to the capital city of the empire, is confirmed by P. Amiot, who, after taking magnetic observations at Peking for several years, found the variation of the needle there to be constantly from 2° to 2° 30′.

Upon a due consideration of all these historic data, in connection with the comparison of the European and Oriental names of the magnet, the magnetic needle, and the compass, it cannot appear to any one to be a rash conclusion, that the knowledge of the natural production, as well as of its wonderful applicability in navigation, existed first in China, and was communicated by the intervention of the Arabs to the nations of Europe, probably on occasion of the more frequent intercourse between Europe and the East to which the Crusades gave rise.

But before the Chinese had applied the magnet to use in navigation, it was employed among them in the construction of *magnetic cars* by which travellers on land directed their course. Not to cite those stories of the Chinese relative to these cars which lose themselves in a fabulous antiquity, the earliest historic allusion to them dates in the first half of the second century, when the Emperor Tcheou Koung, as it is related, gave to some embassadors from Tonkin and Cochin-China "five travelling cars, so constructed as always to indicate the direction of the south.—The cars which showed the south," it is added, "always went in front, to show the way to those who were behind, and to make known the four cardinal points." In the year 235, a Chinese emperor ordered one Makiun to construct a "car which would show the south," to be deposited in a sort of Museum; and we are informed that the invention had then, for some time, been lost, and was recovered by the ingenuity of Makiun. In a book of annals of the dynasty of the Tsin, the magnetic car of a previous age is thus described: "The figure sculptured in wood, standing upon the magnetic car, represented a genius dressed in feathers. In whatever direction the car inclined or turned, the hand of the genius pointed invariably to the south. When the Emperor went out in form, in his carriage, this car led the van, and served to show the four cardinal points." From the year 235, the construction of a magnetic car seems to have been a puzzle which different Chinese emperors proposed to the ingenious men of their courts, and the knowledge of the invention appears to have been confined within very narrow limits.

Between 806 and 820, under the Thâng dynasty, were first constructed cars called *Kin koung yuan.* These were magnetic cars to which had been added a sort of drum called *Ki li kou*, a piece of mechanism which may remind one of some curious public time-pieces still to be seen in old cities of Europe. A *drum-car* is thus described by a Chinese author: "It had two stories, in each of which was a wooden man holding erect a mallet of wood. As soon as the car had run one *ly*,* the wooden man of the lower story struck a blow upon a drum, and a wheel placed at the middle of his height made one revolution. After the car had run ten *lys*, the wooden man of the upper story struck a little bell."

The magnetic car cannot be traced later than 1609. In that year was published a celebrated Encyclopedia, which contains the following passage, accompanying a design of the human figure which was placed upon the magnetic car: "This is a car ornament, of which the dimensions are as follows: It is one foot and four inches in height, and in breadth at the bottom seven inches and four lines. At the extremity of the axle-tree of the car is pierced a round hole of three inches and seven lines in diameter. In this hole moves a peg of the same size, on which is

* A measure of distance variously estimated. John Francis Davis, in his *History of China*, computes thirty *lys* in one English mile.

placed the figure of a man sculptured in *jade*,* whose hand always points to the south. This figure had motion in the hole, and turned. In the years Yan Yeou, (from 1314 to 1320,) it was an object to determine the position of the monastery of Yao mou ngan, and the figure on the magnetic car was made use of for this purpose."

Art. III.—*A Method of determining the Temperature of the Mercury in a Siphon Barometer, from the observed upper and lower readings ; and of testing the accuracy of the instrument ;* by Farrand N. Benedict, Prof. Math. and Civil Engineering, Univ. of Vermont.

It has long been known that a true determination of the temperature of the mercurial column, is essential to the accuracy of barometrical results. The apparatus now in use for this purpose is a thermometer encased in the brass mounting, with its bulb contiguous to the tube of the barometer. While there can be no doubt that the attached thermometer has answered a useful purpose for indicating approximately the temperature of the mercurial column, it is equally evident that its indications are not to be relied upon in many cases within the requisite limits of exactness. These cases, in the present state of science, are the most common and generally the most interesting. When the subjects of investigation are such as to admit of a choice of the places of observation, as the vaults of observatories or large and deep cellars, the temperature may be assigned with all necessary precision. But in the most of physical questions, like those relating to the barometrical measurement of altitudes or to detecting the horary and diurnal variations of atmospheric pressure, the errors incident to this mode of appreciating the temperature, under ordinary circumstances, are necessarily considerable. To entitle the attached thermometer to confidence, its bulb should be a long cylinder, of a diameter equal to that of the barometric tube, and similarly exposed to the surrounding influences of temperature. But these conditions have proved difficult to satisfy. Bunten's mountain barometer, which is probably the most perfect portable instrument of the kind now in use, is faulty in each of these respects, and, to a great extent, necessarily so. The brass mounting is a hollow cylinder with two rectangular orifices nearly op-

* A hard stone, of variegated hue.

posite to each other, about four tenths of an inch wide, parallel to the axis, and extending 9 or 10 inches from the extremities towards the centre. The design of this is to expose to view the extremities of the column, and to allow the requisite movement to the vernier. The remaining central portion, which is about 15 inches in length, and has no perforation through its surface, embraces the attached thermometer. This arrangement evidently exposes the bulb and the tube to different influences. The bulb is comparatively small, and its connection with the mounting is more intimate than it is with the tube, and consequently it tends to indicate the temperature of the former more truly than that of the latter; and more especially so as a like connection between the tube and the mounting is unattainable with a due regard to the safety of the instrument. And besides, allowing the attached thermometer to mark truly the temperature of that part of the column in its vicinity, and which, like it, is protected by the mounting, it might materially err in respect to the remaining portions which are exposed to the direct and variable influences of the atmosphere. These remarks, suggested by the construction of the instrument, I verified experimentally in the following manner. I filled with mercury a tube 14 inches long and of a diameter not much larger than that of the barometric tube, and inserted into the open end a tube of less diameter; joining the two firmly with sealing wax. This was introduced into the central part of the brass mounting. I took a series of observations with this instrument in a cellar where the temperature was low and uniform, and another series in a room where the temperature was high and also uniform. In both these series of observations the temperature indicated by the attached thermometer must have been very nearly the same as that of the mercury in the tube. Denoting the means of these temperatures by $(t,)$ (t'') respectively, and the mean altitudes of the upper surface of the mercury by $(a,)$ $(a'',)$ we evidently have $t''=t+A(a''-a)$; A being a constant depending upon the volume of mercury and the diameter of the lesser tube. For the same reason, if (t') is the temperature of the mercury at any other time, and (a') the reading of the upper surface, we have $t'=t+A(a'-a)$. Eliminating the constant A between these two equations, and resolving for $(t',)$ there results $t'=\frac{t''-t}{a''-a}(a'-a)+t$ (1). I then made the following observations.

1		31.1	31.1	31.1		–
2	5′	43.8	42.8	39.0	4.8	3.8
3	10′	56.5	53.6	49.1	7.4	4.5
4	15′	63.6	60.0	56.2	7.4	3.8
5	20′	67.8	64.4	62.2	5.6	2.2
6	25′	69.4	67.3	65.9	3.5	1.4
7	30′	70.0	68.9	67.6	2.4	1.3
8	35′	70.0	69.8	69.0	1.0	0.8

The first observation was made in a large unoccupied room where the instrument, having been suspended for some hours, indicated a temperature of 31.1 degrees Fah. The instrument was then quickly removed, together with the detached thermometer, to a room at the temperature of 70 degrees, in which all the succeeding observations were made. The second vertical column expresses the time in minutes after the first observation. The 3d, 4th and 5th express in that order the temperatures of the detached and attached thermometers, and of the mercury in the tube, calculated according to formula (1). The 6th and 7th columns express respectively the number of degrees the temperature of the mercury in the tube was behind the attached and detached thermometers. From this table it appears that, after the barometer had been suspended a quarter of an hour for example, the detached thermometer errs as an index of the temperature of the mercurial column by 7.4 degrees, and the attached thermometer by 3.8 degrees; and that the corresponding errors, after half an hour's suspension, are 2°.4 and 1°.3 respectively. These errors would have been somewhat diminished if the diameter of the tube had been strictly equal to that of the barometric one; but on the other hand they might have been aggravated and rendered more uncertain if the tube had been as long as the barometric one, and had not the temperature of the room been sustained at an uniform height. The observations of the table were made with care under circumstances favorable to accuracy, and were verified by three or four other tables, with which it substantially agreed. From the frequency of the observations, some slight errors of time may have been committed, but too inconsiderable to affect the particular object of the experiment.

We conclude therefore that the attached thermometer is an uncertain index of the temperature of the mercurial column, except in those rare cases when the temperature of the air is known to be uniform, and not even then until after nearly an hour's suspension of the barometer.

To appreciate the temperature of the mercurial column throughout its whole extent, in a siphon barometer of which the two branches are cylinders of equal diameters, I propose the following method.

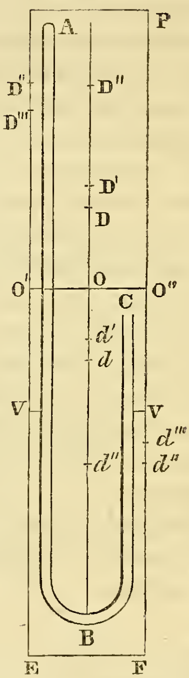
Let ABC represent the tube of a siphon barometer, of which those portions at least within the ranges of the mercurial surfaces are cylinders of equal diameters; and let O be the zero point of the scale D″B, which is supposed to be inexpansible by heat.

Suppose the summits of the convex surfaces of the column in the two branches, at any time, are at D, *d;* and put OD = upper reading $= a$

O*d* = lower reading $= b$

temperature $= t$

Fig. 1.



If the temperature increases to $(t',)$ while the atmospheric pressure remains unchanged, the masses of mercury in the two branches will evidently not be altered, and the surfaces will rise to some points D′, *d′*. Suppose now the temperature (t') to be constant, and the atmospheric pressure to increase. For the sake of reference to the figure, we have supposed the temperature and pressure, whenever they change to increase; but this can lead to no error when the contrary is the case, as an erroneous supposition would be corrected by the sign. Consequent upon this increase of pressure, the surface *d′* will descend to some point *d″*, and the surface D′ will ascend to some point D″. Since the tube D′D″ contains a volume of mercury equal to that which *d′d″* did under the first pressure with the temperature $(t',)$ and since the diameters of these tubes are equal, their altitudes must be equal, and therefore D′D″ = *d′d″*; (1.)

If (ε) represents the ratio of expansion in height of mercury in a cylindric glass tube, due to one centigrade degree; and $(p,)$ (p') the altitudes of cylinders having diameters equal to those of the barometric tube within the ranges of the mercurial surfaces, and capacities respectively equivalent to the volumes of mercury in the longer and shorter branches of the siphon at the epoch of the first observation when the temperature was $(t;)$ we have

$$DD' = \varepsilon(t'-t)p$$
$$dd' = \varepsilon(t'-t)p',$$

and therefore $DD' + dd' = \varepsilon(t'-t)\,(p+p')$.

We derive from the figure $D'D'' = OD'' - OD - DD'$
$$d'd'' = Od'' - Od + dd'.$$

Equating the second members of these last equations, according to (1), and denoting the upper reading OD'' by $(a_,)$, and the lower reading Od'' by $(b_,)$, and substituting for $DD' + dd'$ its value expressed above; we have $a_, - b_, - (a-b) = \varepsilon(t'-t)(p+p')$, (2) which is of the form $a_, - b_, - (a-b) = A(t'-t)$, (3) where A is a constant co-efficient, since (ε) is constant, and $(p+p')$ is constant for the same barometer. This equation exhibits the relation between the elements of any two sets of observations, on the supposition that the scale is not affected by a change of temperature.

To correct this for the expansion of the scale, let D″EFP represent the brass mounting which bears the scale D″O′ O″F; and suppose the imaginary zero point O to have been assumed in the same horizontal line with the zero point O′ or O″ of the brass scale at the temperature (t). Since the expansion of brass is more than twice that of glass, there can be but one point in the graduated line, at which the glass tube and mounting are invariably united. Let this point be V; and put $OV = f$. Let D''', d''' be those points in the brass scale, which are conveyed to D'', d'' respectively by the augmentation $(t'-t)$ of temperature. Denoting by (ε') the ratio of expansion of brass in length due to one centigrade degree, and by (a'), (b') the distances $O'D'''$, $O''d'''$ respectively, which are the actual readings at the temperature (t'); we have
$$D''D''' = \varepsilon'(t'-t)(a'+f)$$
$$d''d''' = \varepsilon'(t'-t)\,(b'-f_,)$$

and therefore $D''D''' - d''d''' = \varepsilon'(t'-t)\,(a' - b' + 2f.)$

We have from the figure $O'D'' = O'D''' + D''D'''$ (3′)
$$O''d'' = O''d''' + d''d''' \quad (3''.)$$

Subtracting the latter of these last two equations from the former, and employing the notation and the above value of $D''D''' - d''d'''$, we have $a_, - b_, = a' - b' + \varepsilon'(t'-t)\,(a'-b'+2f.)$

Eliminating $(a_, - b_,)$ between this equation and (2) there results
$$a' - b' - (a-b) = \varepsilon(t'-t)\,(p+p') - \varepsilon'(t'-t)\,(a'-b'+2f_,) \quad (4).$$

Since the quantity $(a'-b')$ in cylindrical siphon barometers differs from a constant by only about 4 millimètres for a change of 30 centigrade degrees in the value of $(t'-t'_,)$ and since (ε') is less than 0.00002, $\varepsilon'(t'-t)\ (a'-b'+2f)$ can rarely differ from a constant mean so much as 0.0009. Wherefore, putting

$$\varepsilon'(a'-b'+2f)=\text{A}', \text{ a constant, } (5)$$

equation (3) becomes $a'-b'-(a-b)=(\text{A}-\text{A}')\ (t'-t,)$ (6.)

This equation is of the same form as (3,) differing from it only in the value of the co-efficient of $(t'-t,)$ and expresses the relation between the elements of any two sets of observations, embracing the corrections for the expansions of the mercury, scale, and glass tube.

If the volume of mercury $(p+p',)$ with which the barometer is charged, were known, as may have been determined with exactness by weighing the instrument before and after filling; and also the point at which the tube and mounting are united, which makes known the value of $(f,)$ then would A and A′ be known; and (6) would give us

$$t'=t+\frac{a'-b'-(a-b)}{\text{A}-\text{A}'};\ (7)$$

which shews the mean temperature of the whole column in terms of the constants A, A′, $(a,)\ (b,)\ (t.)$

But if A and A′ are not known with great exactness; if we compare the elements $(a'')\ (b'')\ (t'')$ of any other observation, with $(a,)\ (b,)\ (t,)$ we have in like manner

$$a''-b''-(a-b)=(\text{A}-\text{A}')\ (t'-t)\ (8)$$

Eliminating $(\text{A}-\text{A}')$ between (6) and (8,) there results

$$\frac{a'-b'-(a-b)}{a''-b''-(a-b)}=\frac{t'-t}{t''-t};\ (9)$$

which expresses the relation between the elements of any three sets of observations. Solving (9) for (t') we have

$$t'=t+\frac{t''-t}{a''-b''-(a-b)}\,[a'-b'-(a-b.)]\ (10.)$$

Wherefore, knowing the elements of any two observations $(a,)$ $(b,)\ (t)$ and $(a'',)(b'',)(t'',)$ we have the temperature (t') in terms of its corresponding readings $(a',)\ (b'.)$

It is evident that the observations $(a,)\ (b,)\ (t)$ and $(a'',)\ (b'',)$ $(t'',)$ should be made with great care, in places subject for the time to but slight variations of temperature, so that the thermometer which is used, either attached or detached, may be depended upon as indicating truly the temperature of the mercury. It is evident also, that accuracy would be materially promoted by using the means of a number of successive observations rather than individual ones; and also by choosing such temperatures that $(t''-t)$ may be as large as circumstances will permit.

An example may serve the purpose of illustrating the practical application of the formula:—to determine the numerical co-efficients of (10) for No. 366 Bunten's mountain barometer, I made the two following sets of observations.

$$a=393.575,\ b=358.760,\ t=-3.22$$
$$a''=391.746,\ b''=355.043,\ t''=+16.73.$$

Here, as throughout this paper, unless the contrary is expressed, the unit in length is a millimètre, and the degrees are those of the centigrade scale. The formula, however, is equally applicable to any other denominations. The first set is the mean of ten successive hourly observations, in which, during the whole time, the temperature was so uniform as to vary but 1°.7. In this, as in the second series, the barometer had been suspended some hours before the first observation of each series was made. The second set is the mean of seven hourly observations, during which time the attached thermometer varied only 0.6 of a degree. To remove what may seem a fallacious aspect of exactness from the number of decimal places in the readings, I would observe that the scale is graduated in millimètres, which are sub-divided into tenths by a vernier, and these, by careful reading, may be divided into halves or quarters, by the eye. The third decimal place results from the process of taking means, and depends for its exactness, upon the number of observations taken. Substituting these observed values of $(a,)$ $(b,)$ $(t,)$ $(a'',)$ $(b'',)$ $(t'',)$ in (10,) we have

$$t'=-3.22+\frac{19.950}{1.888}(a'-b'-34.815;)$$

or, after reduction, $t'=10.576\,(a'-b'-35.12)$ (10′.)

If, for example, the upper reading is 392.35, and the lower one 356.63, then, according to the formula, the temperature will be 6.35 degrees.

The temperatures calculated by this formula for No. 366 Bunten's barometer I found to differ very rarely so much as one degree from those indicated by the attached thermometer, and most frequently not half that, when the observations were made with suitable care in a place of comparatively uniform temperature; and the more confidence I had in the correctness of the observations, the closer the agreement seemed to be.

This formula, like all others relating to the barometer, supposes an exact instrument. It is desirable therefore to have the means of testing its accuracy of construction, and, if faulty, of applying a suitable correction.

The imperfections of a barometer may chiefly be classed under the following heads.

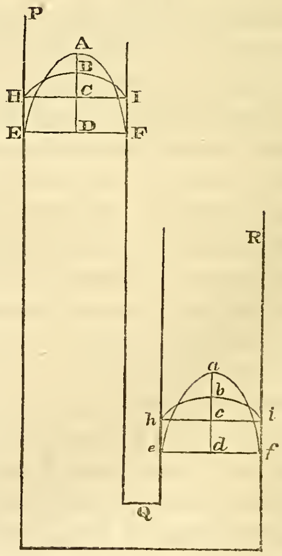
1. An erroneous scale.
2. An imperfect vacuum.
3. Variableness of the friction of the mercury on the interior surface of the tube.
4. The want of equality and uniformity of those parts of the two branches within the range of the mercurial surfaces.

The first of these must evidently occasion uncertain results in the calculated temperature, as well as in every other object of research, and the above formula furnishes no means of detecting or appreciating the error of the scale. An imperfect vacuum, although it influences the length of the column, and on *this* account injures the instrument, has no effect upon the calculated temperature. For, in this respect, it is evidently immaterial whether the inferior surface falls, and the superior one rises by atmospheric pressure alone, or whether it is modified by the elasticity of the enclosed air.

The third imperfection, although little attention has been bestowed upon it hitherto, is one to which barometers of all constructions are exposed, and is probably among the most difficnlt to rectify. The effects of this are to sustain the column at a height different from that due to the atmospheric pressure, and also to change the *forms* of its convex terminations. Both these circumstances occasion error as it respects the height of the column, while the latter, or change of form only, can affect the correctness of the calculated temperature.

The altitudes of the segments which terminate the column are found to vary more or less at different times in the same barometer. In some, the variation is quite inconsiderable, if necessary care is taken in observing; while in others, one or both the terminal surfaces may assume all forms from a plane to an apparent hemisphere. When the atmospheric pressure is increasing, the inferior meniscus tends to become less convex, and the superior one more so. For, as the column lengthens, and the mercury consequently descends in the shorter branch of the siphon, the cylindric surface of mercury which is in immediate contact with the glass tube is retarded by its friction against the glass, and retards in its turn, though in a less degree, the next concentric surface of mercury; and this the succeeding one, and so on; the central filament being least retarded of all. This would cause the inferior meniscus to become less convex when the column is lengthening, and more convex when it is contracting. In like manner, the superior meniscus would have its convexity increasing while that of the inferior one is diminishing, and vice versa. This tendency, which in good barometers, I apprehend is small, may be chiefly, and perhaps sufficiently counteracted by causing the barometer to vibrate once or twice far enough to produce an oscillation of the column in respect to the axis of the tube, and then, after having firmly secured the instrument in a perpendicular position, by giving it a few gentle taps with the fingers. These irregularities are greatly increased in some barometers by the *variable* adhesiveness of the mercury to the sides of the tubes, at different sections of them, arising partly perhaps from the impurity of the mercury, but more probably from imperfections of the interior surfaces of the tubes. If these latter imperfections exist to any considerable extent, which may be ascertained by measuring the altitudes of the terminal convex segments of the column, the barometer is unfit for delicate purposes; not merely because the temperature is thereby rendered uncertain, but more particularly from their influence upon the height of the column. When the altitudes of these terminal segments are not so variable as to prove fatal to the instrument, it is desirable to apply a suitable correction to the formula for temperature.

Fig. 2.



For this purpose let PQR represent the tube of a siphon barometer; EAF, *eaf* the *forms* of the terminal segments of the column, when the upper and lower readings are respectively (a,) (b;) HBI, *hbi* the *forms* and *positions* of these segments, when the readings are (a',) (b'). If the two meniscuses of the longer branch are similar, and also the two meniscuses of the shorter one, it is evident that (a') and (b') would require no correction; since the correction for (a',) for example, is obviously AB, the height to which the vertex B of the meniscus HBI must rise if this meniscus should assume the form of that of EAF, without displacing the body of the column below it. Suppose then the parts of the column in the vicinity of the circle HI to have such a horizontal tendency towards the axis of the tube, without disturbing the column below, as to cause the meniscus HBI to take the form of EAF. We shall then have this equation:

Meniscus EAF = meniscus HBI + cylinder HEFI. (11.)

Put height AD of meniscus EAF = H.

Height BC of meniscus HBI = H′.

Radius of tube ED = r.

Correction AB = x.

Height of cylinder CD = y.

Circumference of a circle whose diameter is unity $= \pi$.

And let the capacity of any meniscus EAF be represented by (πr^2) multiplied by a function F (H) of its height. Equation (11) therefore becomes $\pi r^2 . F(H) = \pi r^2 . F(H') + \pi r^2 y$.

From the figure we have $H = H' + y + x$.

Dividing the first of these equations by $(\pi r^2,)$ and eliminating $(y,)$ we have $x = H - H' + F(H') - F(H.)$ (12.)

It remains only to determine F (H,) F (H′,) which depend upon the form of the meniscus.

If the tube is small, the meniscus differs insensibly from the segment of a sphere, (Mécanique Céleste, 9334.) And generally, since the meniscus in barometer tubes is a small portion of the solid of revolution of which it is a segment, every practical purpose would be answered by considering it a common paraboloid. This being so, we have $F(H) = \frac{1}{2}H$, and $F(H') = \frac{1}{2}H'$; and consequently (12) becomes $x = \frac{H - H'}{2}$, (13.) Wherefore (a') is corrected to $a' + \frac{H - H'}{2}$, (14.)

In like manner, denoting the corresponding heights of the meniscuses in the lower branch by $(h,)$ $(h',)$ we shall find (b') to become $b' - \frac{h - h'}{2}$, (15;) and consequently $(a' - b')$ becomes, after correction, $a' - b' + \frac{H + h}{2} - \frac{H' + h'}{2}$, (16.) Hence, to find the correction for the difference of readings $(a' - b',)$ we subtract the half sum of the heights of the meniscuses which terminate this column from the half sum of the heights of the meniscuses which terminate the column of which the readings are $(a,)$ $(b.)$

It is evident from (16) that no error will be introduced, and consequently no correction will be needed, even if the forms of the meniscuses do vary, provided the sums of their altitudes for each column are constant; that is, provided the height of the upper meniscus increases as that of the lower one diminishes, and vice versa. This indeed is the tendency in good tubes properly filled, and furnishes a convenient and useful test.

Example. I took two observations with No. 365 Bunten's barometer, in which the altitudes of the meniscuses were particularly subject to variation. The elements of the first observation were

$a=407.75$, $b=363.11$, $H=1.68$, $h=1.75$; and of the second $a'=400.11$, $b'=360.09$, $H'=0.90$, $h'=1.60$.

According to (16) therefore, the corrected difference of readings is 40.49; while the observed difference is 40.02.

We have hitherto supposed the tubes, within the ranges of the mercurial surfaces, to be of equal and constant diameters. It is desirable to test the accuracy of the instrument in this respect, and, if necessary, to apply the suitable correction for temperature. A correction also for capillarity is equally important, and may be directly applied by knowing the diameter of the tube at the extremity of the column.

We will suppose the tubes within the ranges of the mercurial surfaces to be frustums of cones; and, besides the notation and figure employed in determining (9,)

Put R=radius of the tube at D,

r=radius of the tube at d,

θ=angle which the axis of the tube makes with its side at D,

θ'=angle which the axis of the tube makes with its side at d;

and suppose the cylinders, whose altitudes are ($p_{,}$) ($p'_{,}$) to rest on bases at D, d, respectively equal to the horizontal sections of the barometric tube at these points.

Regarding the tubes DD′, dd', from the necessary smallness of their heights, as cylinders, we have

Capacity of the tube $DD'=\pi\varepsilon R^2 p(t'-t_{,})$ (17.)

Capacity of the tube $dd'=\pi\varepsilon r^2 p'(t'-t_{,})$ (18.)

Radius at $D''=R+(a_{,}-a)\sin.\theta$.

Radius at $d''=r+(b_{,}-b)\sin.\theta'$.

$$\text{Frustum } DD''=\frac{\pi}{3}(a_{,}-a)\,[R^2+[R+(a_{,}-a)\sin.\theta]^2+R[R+(a_{,}-a)\sin.\theta]^2,]\ (19.)$$

Frustum $dd''=\frac{\pi}{3}(b_,-b)\,[r^2+[r+(b_,-b)\sin.\theta']^2+r[r+(b_,-b)\sin.\theta']^2]$ (20.)

It is evident, whatever may be the forms of the tubes, that

capacity of D′D″ = capacity of $d'd''$ (21.)

But, from the figure cap. D′D″ = cap. DD″ − cap. DD′

cap. $d'd''$ = cap. dd'' + cap. dd'.

Equating the second members according to (21,) and transposing, we have

cap. DD″ − cap. dd'' = cap. DD′ + cap. dd';

or, denoting the sum of the second members of (17) and (18) by (I,) (22)

the second member of (19) by (K,) (23)

and the second member of (20) by (L,) (24)

we have K − L = I (25.)

In like manner, if the observations $(a_{,,,}\ b_{,,,}\ t_{,,,})$ $(a_3, b_3, t_{3},)$ $(a_4, b_4, t_{4},)$ be compared respectively as above with $(a, b, t,)$ we shall have $K'-L'=I'$, $K''-L''=I''$, $K'''-L'''=I'''$; (26) the terms of these equations being functions similar to those of (25.)

The four equations (25) and (26,) after correcting the readings, are sufficient to determine the unknown quantities $\frac{R^2}{r^2}$, θ, θ' and $\left(\frac{R^2}{r^2}p+p'\right)$ which these equations contain.

From the minuteness of the angles $(\theta,)$ $(\theta',)$ we may use $(\theta,)$ (θ') in the places of $\sin.\theta$, $\sin.\theta'$; and neglect the terms which contain the second powers of these angles. This will materially abridge labor without impairing the practical accuracy.

As our limits will not permit us to discuss the general question, we will select that particular case only in which the two branches are *cylinders* of unequal diameters; and which is the most important, if not the only one that needs to be regarded in the use of the barometer.

Here $\theta=0$, $\theta'=0$

$K=\pi R^2(a_,-a)$ according to (23)

$L=\pi r^2(b_,-b)$ " (24)

$I=\pi\varepsilon(R^2p+r^2p')$ " (22)

Substituting these in (25,) and dividing by $(\pi r^2,)$ we have

$$\frac{R^2}{r^2}(a_,-a)-(b_,-b)=\varepsilon\left(\frac{R^2}{r^2}p+p'\right)(t'-t_,)\quad(27.)$$

In like manner, if we compare the elements $(a_{,,,}\ b_{,,,}\ t_{,,,})$ $(a_{,,,,}\ b_{,,,,}\ t_{,,,,})$ with $(a,\ b,\ t_{,})$ successively, we shall have

$$\frac{R^2}{r^2}(a_{,,}-a)-(b_{,,}-b)=\varepsilon\left(\frac{R^2}{r^2}p+p'\right)\ (t''-t_{,})\ (28)$$

$$\frac{R^2}{r^2}(a_{,,,}-a)-(b_{,,,}-b)=\varepsilon\left(\frac{R^2}{r^2}p+p'\right)\ (t'''-t_{,})\ (29)$$

Eliminating $\varepsilon\left(\frac{R^2}{r^2}p+p'\right)$ from the last three equations, we shall have

$$\frac{\frac{R^2}{r^2}(a_{,}-a)-(b_{,}-b)}{\frac{R^2}{r^2}(a_{,,}-a)-(b_{,,}-b)}=\frac{t'-t}{t''-t}\ (30.)$$

$$\frac{\frac{R^2}{r^2}(a_{,,}-a)-(b_{,,}-b)}{\frac{R^2}{r^2}(a_{,,,}-a)-(b_{,,,}-b)}=\frac{t''-t}{t'''-t}\ (31.)$$

Solving (31) for $\left(\frac{R^2}{r^2}\right)$ we have

$$\frac{R^2}{r^2}=\frac{(t'''-t)\ (b_{,,}-b)-(t''-t)\ b_{,,,}-b)}{(t'''-t)\ a_{,,}-a)-(t''-t)\ (a_{,,,}-a)}\ (32.)$$

The readings in (30) and (32) are those of the supposed inexpansible scale. To change these equations into terms of the readings taken from the brass scale, after being corrected for the height of the meniscuses, we have

$$\left.\begin{array}{ll}\text{from } (3') & a_{,}\ =a'\ +\varepsilon'(t'\ -t)\,(a'\ +f)\\ & a_{,,}\ =a''\ +\varepsilon'(t''\ -t)\,(a''\ +f)\\ & a_{,,,}=a'''+\varepsilon'(t'''-t)\,(a'''+f)\\ \text{and from } (3'') & b_{,}\ =b'\ +\varepsilon'(t'\ -t)\,(b'\ -f)\\ & b_{,,}\ =b''\ +\varepsilon'(t''\ -t)\,(b''\ -f)\\ & b_{,,,}=b'''+\varepsilon'(t'''-t)\,(b'''-f)\end{array}\right\}\ (33)$$

Substituting in (32,) and reducing, we have

$$\frac{R^2}{r^2}=\frac{b''-b+\varepsilon'(t''-t)\ (b''-b''')-\frac{t''-t}{t'''-t}(b'''-b)}{a''-a+\varepsilon'(t''-t)\ (a''-a''')-\frac{t''-t}{t'''-t}(a'''-a)}\ (34)$$

Neglecting the third terms in the numerator and denominator, as they are nearly equal and very small, we have

$$\frac{R^2}{r^2}=\frac{b''-b-\frac{t''-t}{t'''-t}(b'''-b)}{a''-a-\frac{t''-t}{t'''-t}(a'''-a)};\ (35)$$

which is the same as (32).

In like manner, substituting in (31,) and resolving for $(t'-t)$, we have

$$t'=t+\frac{(t''-t)\left[a'-a-\frac{r^2}{R^2}(b'-b)\right]}{a''-a-\frac{r^2}{R^2}(b''-b)+(t''-t)e'\left[a''-a'-\frac{r^2}{R^2}(b''-b')\right]}\ (36.)$$

Neglecting the fourth term in the denominator from its minuteness, we have

$$t'=t+\frac{t''-t}{a''-a-\frac{r^2}{R^2}(b''-b)}\left[a'-a-\frac{r^2}{R^2}(b'-b)\right].\ (37)$$

In these last four equations $(a',)$ $(a'',)$ $(b',)(b'',)$ are the readings after being corrected, if necessary, for the heights of the meniscuses. These formulæ are sufficient for determining the relative diameters of the two branches of the siphon, and the mean temperature throughout the mercurial column.

An example will serve to illustrate the process.

To test No. 366 Bunten's mountain barometer, and to deduce the formula for the temperature of the mercurial column, I made the following observations.

	Upper reading.	Lower reading.	Heights of upper meniscuses.	Heights of lower meniscuses.	Temperature of mercury.
1	a =400.71	b =365.04	H =1.73	h =1.48	t = 6.20
2	a' =a'	b' =b'	H′ =H′	h' =h'	
3	a'' =394.64	b'' =356.50	H″ =1.80	h'' =1.69	t'' =31.32
4	a'''=389.60	b'''=352.43	H‴=1.77	h'''=1.64	t'''=21.40

The second observation is any one of which the temperature is demanded. The remaining three were taken agreeably to the suggestions under (10.) And it is farther important in this case, that at least two of the upper readings should differ considerably from each other in value; which may be effected by observing at the base, and on the summit of a hill, or under different atmospheric pressures at the same place. In this example, however, owing to the accidental loss of the barometer, the difference between any two upper readings, is not so great as it ought to be.

By (14) and (15)

a' is corrected to $a' + \frac{1.73 - H'}{2}$; b' is corrected to $b' - \frac{1.48 - h'}{2}$.

a'' " 394.60; b'' " 356.60.

a''' " 389.58; b''' " 352.51.

The left readings are those found in the formula, which are supposed to have been corrected for the heights of the meniscuses. The readings found in their equivalents, are those taken from the brass scale. Substituting the observed temperature and corrected readings in (35,) we have $\frac{r^2}{R^2} = 1.0013$; so that the diameter of the longer branch being denoted by unity, that of the shorter branch would be 1.0006.

For the temperature, we have, after the necessary substitutions and reductions

$$t' = 10.74(a' - 1.0013\, b' - \frac{H' + h'}{2} - 33.02). \quad (38.)$$

In which $(a',)$ $(b',)$ are the observed readings, and H', h', the height of the meniscuses.

This formula is easy of application, although it provides for imperfections in the instrument, which are not necessary to it, and which may in a great measure, or perhaps entirely, be avoided by ingenuity and care in the construction.

Remarks.—If the tubes of the two branches are cylinders of equal diameters, and their interior surfaces are free from tarnish, or any foreign substance, such as dust, humidity, &c., and are filled with pure mercury, according to the well known rules for this process, the heights of the meniscuses, I am confident, would not vary in such a manner as to require a correction in the formula for temperature. If barometers were thus constructed, with that care which all exact instruments demand, the temperature could be derived from a formula like (10′) in but little more time than would be requisite to read it *accurately* from a thermometer, and record it; and what is still more important, the height of the column would not be subject to those errors which a construction faulty in these respects must occasion.

The means above set forth for determining the mean temperature of the mercury, throughout the whole extent of the column, and for detecting and correcting the defects of the instrument, are *peculiar* to siphon barometers, and give this form a decided advantage over all others.

These formulas may be used, not only to determine the temperature of the mercury, but, supposing this to have been ascertained by any other means, to verify the correctness of the observations; as for example, the correctness of the readings and temperature $(a',)$ $(b',)$ $(t',)$ would be verified by their satisfying equation (38.)

If, in any case, doubt should be entertained as to the parabolic form of the meniscus which in (12,) makes $F(H)=\frac{1}{2}H$, we can put $F(H)=BH$; B being an indeterminate co-efficient. Then as from (12) to (16,) $a'-b'$ would be changed to $a'-b'+B(H+h-H'-h')$; and from equation (10) we should have

$$a'-b'-(a-b)+B(H+h-H'-h')=(A-A')\,(t'-t,)$$

$$a''-b''-(a-b)+B(H+h-H,-h,)=(A-A')\,(t''-t);$$ H, and $h,$ being the altitudes of the meniscuses for a'', b''.

These two equations give the numerical value of B –. To determine the form of the meniscus from this value of B, we have, regarding its vertex as the origin of coordinates, $\int \pi y^2 dx = \pi B y^2 x$. Differentiating, &c. $\frac{1-B}{2B}\cdot\frac{dx}{x}=\frac{dy}{y}\cdot$ Integrating and returning to numbers, we have

$cx=y^{\frac{2B}{1-B}}$; in which (C) is the correction. This is a parabola, if $\frac{2B}{1-B}$ is positive, which becomes the common one, when $B=\frac{1}{2}$. If $\frac{2B}{1-B}$ is negative, it is an hyperbola; which is the common one, if $B=-1$. But the hyperbolic form, it is evident, cannot subsist in a mercurial barometer. Various consequences from the above formulæ, and remarks relating to the construction of the barometer, and the necessary precautions to be taken in observing, my limits compel me to omit.

ART. IV.—*Catalogue of the Mollusca of Middlebury, Vt., and vicinity, with observations;* by C. B. ADAMS, Prof. Chem. and Nat. Hist. Middlebury College, Memb. Bost. Soc. Nat. Hist.

THE utility of catalogues of species, which inhabit distant parts of this country, as materials for ascertaining their geographical distribution, need not be urged. Even a single local catalogue cannot but be of interest and utility. It is obviously important that the stations and the abundance or scarcity of the several species should be designated. Such catalogues should also be drawn up by those whose residence in the region enables them to make numerous observations at all seasons, to detect the rare species and those which appear only for a very limited time during the year.

In obtaining materials for the following catalogue, my acknowledgments are due to Prof. George W. Benedict, of Burlington; also to Messrs. K. Prescott, Luther H. Sheldon, and M. W. Johnson, who have been my assistants in the department of Natural History, and who have detected some of the rare species, which might otherwise have escaped search. That other species may yet be found is by no means improbable, for a species, whose habitat should be as circumscribed as that of *Vitrina pellucida, Drap.*, (see following remarks,) appears to be in this vicinity, may elude the researches of many years. But after the careful search, which has been made in various places and in every station, especially by my assistants, it cannot be expected that any important additions will be made.

MELANIA.

M. depygis, Say. It is remarkable that no species of the family *Melaniana* occur in the New England States, with this single exception, although some are abundant in New York. This species occurs here only in Lake Champlain, where it was first found by my friend Prof. George W. Benedict, in Burlington. It is very rare. I have found several imperfect specimens, and but one with the animal, at Shoreham.

PALUDINA.

P. decisa, Say. This species, so common in the streams and ponds of New England, occurs plentifully in Otter Creek, but rarely in Lake Champlain. Deshayes could not have suggested, as he has, (2d edit. Lam. An. sans Vert. in loc.) that this is the young of *P. ponderosa*, *Say*, had he seen suites of young and old in both species. This species is more nearly related to *P. integra*, *Say*, from which it is well distinguished by Haldeman, (Monog. Limniad. No. 1.)

P. lustrica, *Say*. This species is very abundant in Lake Champlain and in the streams. Its color varies from brown to green in different localities.

VALVATA.

V. tricarinata, *Say*. Abundant in Lake Champlain, of a grass green color.

V. sincera, *Say*. This species occurs plentifully in Putts's swamp, on the New York side of Lake Champlain, opposite Bridport. It is so rare, that a description of the animal may not be without interest.

Foot whitish, swelling and regularly rounded posteriorly, with the anterior lobes sharply angular, somewhat contracted in the middle, less than .3 in. long; *head* anteriorly obtuse and bilobed, —lobes regularly rounded,—whitish, with a tinge of slate color on the top, deepening posteriorly; *mouth* pale-yellowish; *tentacles* filiform, whitish, more than .2 in. long; *eyes* minute, black, shining, situated on the upper and outer part of the posterior side of the protuberance at the base of the tentacles; *branchial cavity* blackish brown on the margin; *plumose branchia* consisting of a stem, on each side of which extend, at right angles to it, about ten filiform obtuse branches, bent in zigzag, shorter near the top, the whole appearing like a feather; *tentaculiform branchia* rather longer than the tentacles, equally slender and obtuse.

LIMNÆA.

L. megasoma, *Say*. This large and rare species I have seen only at Burlington.

L. appressa, *Say*. This species has been found only in or near Lake Champlain. At Burlington it is common. Sometimes it is nearly as much shouldered on the body whorl as the *L. stagnalis* of Europe, from which it differs very slightly.

L. gracilis, *Jay*. This very remarkable species occurs in Lake Champlain. About half a dozen specimens were discovered near Burlington, and have been distributed by Prof. Benedict. A single specimen, large and perfect, but without the animal, I found in Addison. The most striking character of this species is its elongation with a very few whorls. The specimen in my cabinet is one inch in length, and in the convexity of the penult whorl only .15 in. diameter. The last whorl is scarcely broader, except across the lips, both of which are expanded. Although nearly seven times longer than its average breadth, it has only 4½ whorls!

L. pallida, nob. This species has been found only at Shoreham. Since it was described, I have found three living specimens, of a dingy white!

L. elodes, Say. This species is not very common.

L. umbrosa, (?) *Say.* A Limnæa is very abundant in many parts of the New England States, which corresponds very nearly to Say's *umbrosa.* Some specimens, however, have a more prominent columellar fold than is ascribed to that species, and Dr. Gould (Mss.) has proposed for it the name *L. plebeia.* The prominence of this fold is subject to variation, and is not sufficiently marked to constitute alone a good specific character.

L. desidiosa, Say. This species is very common, and is subject to great variation of form, sometimes being elongated and scarcely to be distinguished from *L. elodes.* Other specimens are short, as in Say's fig. (Am. Conch.) and the upper part of the last whorl is much inflated and more or less shouldered, while the lower part is produced. This variety approaches *L. umbilicata, nob.*, which, however, has the umbilicus larger, and the lower part of the last whorl abbreviated, much inflated, and globular, so that the whole shell has the form of a cone with a hemispherical base.

L. caperata, Say. Although common in this vicinity, this species has not been found elsewhere in the eastern states.

Physa.

P. ancillaria, Say. This rare species occurs in Lake Champlain, and in some ponds in Sudbury. In the lake it is remarkable for being sometimes of a deep bay color. The young are not easily distinguished from the next species, although mature specimens differ widely.

P. heterostropha, Say. This species is common here as in many other parts of New England.

P. gyrina ? Say. Of this species a very few specimens only have been found. Although I have not seen authenticated specimens, nor any figure, of Say's species, they correspond so well with his description, that I have not much hesitation in referring them to it.

P. elongata, Say. This species is rather common here. It is rarely seen in Mass., but has been found in New Bedford by my friend C. F. Shiverick, Esq.

The above four species of Physa differ chiefly in the proportions of the spire and aperture, and of the length and breadth, the gradation in these two particulars being parallel, as appears in the following table. The ratio is, of course, subject to some variation, even in mature specimens, which alone should be compared.

	Length.		Breadth.	Ratio.	Length of spire.		of aperture.	Ratio.
P. ancillaria,	.65 in.	:	.48 in.	=1.35.	.1 in.	:	.55 in.	=.18.
P. heterostropha,	.75 in.	:	.45 in.	=1.67.	.25 in.	:	.5 in.	=.5.
P. gyrina?	.55 in.	:	.25 in.	=2.2.	.23 in.	:	.33 in.	=.7.
P. elongata,	.58 in.	:	.25 in.	=2.32.	.28 in.	:	.30 in.	=.93.

Planorbis.

P. lentus, Say, and *P. corpulentus, Say.* These are undoubtedly varieties of the same species, the former being merely a stunted growth of the latter. Very large and beautiful specimens were found plentifully below the falls of Otter Creek, in this village, during the spring of 1839, but last year not one could be found. Some were 1.15 in. in their greatest breadth, and .55 in. in the height of the aperture. This species is common in Lake Champlain.

P. campanulatus, Say. I have found this species only in the Lemonfare river, where it was abundant.

P. bicarinatus, Say. Common.

P. armigerus, Say. Common in swamps. In the dry season it takes refuge among the moist and decaying leaves.

P. exacuous, [*exacutus?*] *Say.* This species is the most depressed and fragile of all our Planorbes. A specimen .24 in. in diameter is only .05 in. in height, and weighs only .05 of a grain. It is found clinging to wood, in still water, on the margins of Lakes George and Champlain, but is not plenty. My friend, J. W. Mighels, M. D., of Portland, has found it rather plentifully in the interior of Maine. In the eastern part of Massachusetts it has been found in several places.

P. parvus, Say. This species is common. One specimen in my cabinet is ¼ in. in diameter.

P. elevatus, nob. This species does not differ much from some varieties of the preceding, and perhaps may not prove entitled to rank as a species. All the specimens which I have seen, however, present that *constancy* of difference which is most important in distinguishing species. One or two specimens have been found in a swamp at Ticonderoga, N. Y.

P. hirsutus, Gould. This species, common in the vicinity of Boston, is rare in this region. It is found in company with *P. exacutus.*

P. deflectus, Say. A very few specimens have been found, in company with *Valvata sincera.*

Succinea.

S. obliqua, Say. This species is frequently confounded, as perhaps it should be, with *S. campestris, Say.* In the Western States this shell is of a pale horn color, but in this vicinity it is of a deep shade of amber. It is common in low grounds under stones and wood. On the Brothers' Islands, opposite Burlington, Prof. Benedict has found very large specimens, one of which in my cabinet is .97 in. long, and .55 in. wide. The animal is more or less thickly mottled with dark purple. In October a thin transparent epiphragm is formed.

S. ovalis, Say. This very fragile species is found only very near water. In low ground, which is covered with a species of flag, and overflowed by Lake Champlain in the early part of summer, I have seen them in immense numbers on the upper part of the flags. *S. putris* of Europe is intermediate in form between this and the preceding species.

S. avara, Say. This species is the young of *S. vermeta, Say.* At this age a viscid substance attaches dirt to the shell, which becomes clean in a mature state. As the young was first described, the name of the adult must be rejected. This species is found in the same station with *S. obliqua,* and in this region is rather rare.

Bulimus.

B. lubricus, Drap. This species is remarkable for its extensive geographical distribution, being dispersed over a large part of Europe. It is rather common in this vicinity, has been found in great abundance near Boston by Dr. Gould, and was seen near Lake Winnipeck and the Lake of the Woods by Say. With equal propriety the species has been referred to Achatina, but as

Deshayes remarks, (Lam. An. sans. Vert. 2nd edit.,) in common with some others, it establishes a passage between the two genera, and proves the uselessness of one of them.

Pupa.

P. armifera, Say. Of this species, not before known this side the Alleghany Mountains, (Gould, Monog. Bost. Journ. Nat. Hist. Vol. III, p. 401,) I have found a very few specimens in Bridport on the borders of Lake Champlain, and Prof. Benedict has found it at Crown Point.

P. badia, nob. This species was discovered in company with the preceding by Prof. Benedict. Dr. Gould (op. cit.) remarks that it is "almost precisely like" *P. marginata, Drap.* That species has a narrower aperture and wider umbilicus. It is quite possible however that a comparison of numerous specimens may establish their specific identity.

P. albilabris, Ward's letter. This species is well known as Say's *Cyclostoma marginata.* The late lamented Dr. Ward, of Roscoe, Ohio, ascertained that it was a Pupa, and, as Say's specific name had been pre-occupied in this genus, proposed for it the name which we have given. A few specimens only in this region have been found by Prof. Benedict.

P. ovata—syn. *Vertigo ovata, Say.* This species has been mistaken by some for *P. modesta, Say*, but a specimen with all the teeth fully developed leaves no doubt in my view of the correctness of others, who have regarded it as *P. ovata.* It is rare in this vicinity, but is more common near Boston.

P. contracta, Say. This species is found quite plentifully. Mature specimens vary considerably in size.

P. exigua, Say. This very neat little species is rather common.

P. milium, Gould. This is the most minute shell, which has been described in this country. Twelve mature specimens together weighed less than .06 gr., or .005 gr. each. The *Delphinula serpuloides, nob.*, the least of the marine shells of New England, weighs precisely twice as much. The dimensions of *Pupa milium* are, length .06 in., breadth .03 in. The *Helix pygmæa, Drap.*, according to Turton, (Land and Fresh Water Shells of Great Britain,) is .05 in. broad, and Deshayes remarks (op. cit.) that it is "une des plus petites espèces connues." This Pupa therefore is probably the most minute of known shells, with the exception of the microscopic Cephalopods.

This species was not "first discovered" by Dr. Gould, as claimed by him, (op. cit.,) but was discovered in July, 1839, by Mr. Sheldon. I supposed, until the publication of Dr. G.'s description, that it had long been known to him, and the privilege of describing it was tacitly yielded to his claim of discovery.

Helix.

H. albolabris, *Say*. This species is every where found, but is most abundant in company with *Succinea obliqua*, *Say*, at the Brothers' Islands, and in the same company on an island near the N. E. extremity of Lake George. A pink variety is rare. This species sometimes attains a size of 1.35 in. in its greatest diameter; but another mature specimen, from a different locality, is only .9 in. in its longest dimension. A specimen from Cincinnati, which I received from my friend J. G. Anthony, Esq., very nearly approaches in size to *H. major*, *Binney*, being 1.4 in. broad.

H. thyroidus, *Say*. Only three or four specimens of this species have been found in this vicinity. They had a tinge of pink.

H. palliata, *Say*. This species is as rare here as the preceding.

H. monodon, *Rack*. and *H. fraterna*, *Say*. These species are common on hill sides. In some specimens now before me the umbilicus is entirely covered by the reflected lip, which is characteristic of the *fraterna*; but others have it scarcely encroached upon by the lip, and are therefore the *monodon*. As the very numerous specimens, which I have collected, present every intermediate condition, as well as also in respect of size and elevation of the spire, and especially as their gradations in these particulars are by no means parallel, I have not been able to find two species among them. With such authorities, however, as Say and Binney, for their specific difference, I cannot but distrust the correctness of my conclusion.

H. concava, *Say*. This species is rare in this vicinity.

H. pulchella, *Müll*. This species is very abundant in this town, so that I have taken eleven hundred specimens in one hour. The shell is stouter than in many other parts of the country. The species is remarkable for its very extensive geographical distribution. It is well known as a native of Great Britain and of a large part of Europe. In this country, it has been found in Maine by Dr. J. W. Mighels, of Portland, and was seen by Say as far west as Council Bluffs, on the Missouri river; from Prof.

Foreman, of Baltimore, I have received specimens collected at Charleston, S. C. At many intermediate places it has been found by numerous observers.

H. Sayii, Binney. This species is very rare here, only one good specimen, and a few partially decayed, having been found.

H. tridentata, Say. This species is not common in this region. Its size is less than that of specimens from the western states.

H. labyrinthica, Say. This singular little species is not rare.

H. indentata, Say. This species is rare. The animal is remarkable for being of a rather light blue color.

H. arborea, Say. This species is very common. It inhabits both dry and wet lands. In the former situation the shell is of a pale horn color; in the latter it is of a deep brown, and the animal is black. The latter variety attains a greater size, some specimens in my cabinet being .3 in. broad.

H. inornata, Say. One specimen only has been obtained here. With this exception, I believe this species has not been found in New England.

H. alternata, Say. This species is very common. At the Brothers' Islands, it attains its greatest size, some specimens being one inch in diameter.

H. chersina, Say. In April, 1839, this species was found in this town. Not long after it was found near Boston. It is not rare.

H. lineata, Say. This species is not rare. It is of a beautiful light green, and is remarkable for its resemblance to a Planorbis.

H. striatella, Anth. This species, long confounded with *H. perspectiva, Say*, which does not occur in New England, was first recognized as a distinct species by J. G. Anthony, Esq. In this species the last whorl much exceeds the umbilicus in diameter, while in Say's shell it is not more than equal to it. The last whorl in the former is also much larger. Less essential differences are that Say's species is larger, uusally of a darker color, and that it has the striæ more elevated. The *striatella* is quite common here.

H. fuliginosa, Griffith, is rare in this part of Vermont.

H. electrina, Gould, in Binney's Monog. This species was discovered by me in Marion Co., Mo., in Nov. 1837. In August, following, Col. A. Bourne, of Chillicothe, Ohio, forwarded to me specimens from that place. Subsequently I have found it in this town and at Rogers's Rock, Lake George, and Dr. Gould has found it near Boston. It is not rare here, and is associated with *H. arborea*, under logs, &c., both in moist and in dry lands. Dr. Gould has found it only near the water's edge.

This species is remarkable for its close resemblance above to *H. indentata*, *Say*, and beneath to *H. arborea*, *Say*. This resemblance is so striking, that a view of either side alone would lead any one to place it with one or the other of these species. A comparison of both sides easily distinguishes it.*

H. multidentata, *Binney*. This beautiful little species was discovered by Dr. Binney several years since, in Strafford, Vt. Subsequently it has been found in this town very sparingly. It is remarkable for the roseate color of the animal, seen through the semi-transparent shell, and for the *teeth*. These are placed in rows, far within the aperture, on its outer and lower half. The rows are curved, with the convexity towards the aperture, and contain four to six closely approximate teeth, appearing through the shell like glass beads. The number of rows varies from two to four, of which never more than one is visible from the aperture.

H. minuscula, *Binney*. This species, recently discovered in Ohio, has also been found in this town. Under a log, in wet land, I found a large number, but have not found many elsewhere. It exactly resembles *H. pulchella*, *Müll.*, in size and color, but that species is easily distinguished by its reflected lip, enlargement of the last whorl, and small umbilicus.

Vitrina.

V. pellucida, *Drap*. This species was observed first on this continent by Say, who remarks that it "was first found near Coldwater lake, in lat. 48¾° N., under stones, fallen timber, &c. It afterwards occurred, in similar situations, until we approached Lake Superior, when it was no more seen. No species of this genus has been hitherto found in this country; this shell is therefore the more interesting. The specimens which we collected do not appear to differ in any respect from those of Europe."† I

* A description of this species, under the name of *H. Janus*, had been prepared for this article, when I received, through the kindness of Dr. Binney, the remainder of his excellent monograph, printed in anticipation of the next No. of the Bost. Jour. Nat. Hist., in which, not aware that any one had discovered it prior to Dr. Gould, he has quoted from Dr. G.'s MSS. The two following species are described by Dr. B. in the same paper.

† App. Long's Exped. to Source of St. Pet River.

am not aware that it has since been found, until the summer of 1839, when on an excursion to Rogers' Rock, near the N. E. extremity of Lake George, N. Y., I found a number of individuals crawling among moist leaves. On a visit to the same place, last autumn, a very few only were found. These specimens were obtained in a niche in the rock, accessible only by water, within the space of less than a square rod. A careful search in the neighborhood enabled me to detect only one dead specimen, at a distance of ten rods from the little colony.

Although I have not seen specimens of the European shell, I do not doubt that this is the same species, which is figured and described by numerous authors. It differs only in being entirely destitute of the tinge of green, which is mentioned by some of them. It is perfectly hyaline, and for elegance of contour and delicacy of aspect, cannot be surpassed.

Ancylus.

A. parallelus, Hald., Mss. This species has been supposed to be Say's *A. rivularis*, with the brief description of which it agrees very well. But my friend S. S. Haldeman, Esq. informs me that it is distinct. It is rather common in Otter Creek, and in a pond in the east part of Brandon.

A. tardus, Say. Found rather plentifully in a brook in the east part of this town. Mr. Prescott has also found it in the southern part of this State.

Two species of naked Mollusca, of the family *Pulmonea terrestria, Cuv.*, are found in this region, which have a dense shield-like mantle, covering the whole back, the branchial orifice on the right side near the head, and the anus at the posterior extremity. As the latter orifice does not communicate with the branchial cavity, which is immediately behind the head, these species cannot belong to the genus Vaginulus, *Fer.*, to which I had at first referred them on account of the extent of the shield-like mantle. Not having the means here of ascertaining whether any genus has been described for their reception, I am obliged to leave them. One species is (after being preserved in spirit) 1$\frac{2}{5}$ inches long and $\frac{1}{2}$ inch in diameter. The mantle is thickly mottled with a grayish black, and the spots on the back are sometimes confluent. The other species (also in spirit) is about $\frac{1}{2}$ inch long and $\frac{1}{4}$ inch in diameter, and is of a nearly uniform blackish gray color. This species is quite common. A species of LIMAX also occurs of the same size.

ANODONTA.

A. Benedictensis, Lea. This species occurs only in Lake Champlain, where it is abundant.

A. cataracta, Say. At Wallingford, Vt., a very few specimens have been obtained.

Two other species of Anodonta occur, which I have not been able to identify with any species known to me. One of them resembles *A. Wardiana, Lea.*

ALASMODONTA.

A. arcuata, Barnes. That this species is quite distinct from the *margaritifera* of Europe, I have had an opportunity of seeing from a specimen of the latter in the cabinet of Dr. Gould. Barnes's species occurs in Onion river, at Burlington.

A. rugosa, Barnes. This species occurs in Otter Creek and Lake Champlain, but is not common.

A. undulata, Say. This species occurs in Otter Creek.

UNIO.

U. alatus, Say. Abundant in Lake Champlain.

U. gracilis, Barnes. Common in Lake Champlain.

U. compressus, Lea. This species occurs, well characterized, in a rivulet a few miles west of this village. In the east part of this town are specimens which differ so much from the common type as perhaps to constitute a new species.

U. rectus, Lam. This species occurs rarely in Lake Champlain.

U. ventricosus, Barnes. This species is rather common in Lake Champlain. It is subject to great variations of form.

U. luteolus, Lam. This species is very abundant in Lake Champlain. Its variations in form, although less than in the preceding, are considerable. In both, however, the most marked are those of sex.

U. complanatus, Lea. Very abundant in Lake Champlain and elsewhere, but I have not seen one with a white nacre. *Rayed specimens are sometimes seen.*

I have found in Lake Champlain a single specimen of another species, which is unknown to me.

Cyclas.

C. elegans, nob. Rather common in a swamp five miles north of this village. One specimen occurred at Burlington.

C. rhomboida, Say. Very abundant in Lake Champlain. This is the only species which I have seen in the open waters of the lake.

C. partumeia, Say. Common in swamps.

C. calyculata, Drap. In company with *Valvata sincera*, this species was found quite plenty. It has also been found in this town very numerous in a cavity one yard in diameter in a swamp, and it is remarkable that not one could be found elsewhere. Dr. Mighels has found it occurring plentifully in Maine. That the same species of Cyclas should occur so abundantly in this country and in Europe, may seem incredible. But the coincidence is so exact, that were specimens from both continents mingled, I do not think that they could be separated.

The descriptions of native species of this genus are so unsatisfactory, that I do not venture to affix names to two other species, of which one is the largest and the other the least of American species.

General Remarks.—Of the thirty two terrestrial species enumerated above, three certainly, and possibly four, are also widely distributed in Europe; while of the forty five aquatic species, identity with those of Europe appears only in a single instance.

Lake Champlain appears to be the most eastern limit on this continent of the entire family of *Melaniana*, and is also on the boundary between two provinces of the Naiades. *Unio alatus*, *U. gracilis*, *U. rectus*, *U. ventricosus*, and *U. luteolus*, which are common through the western states, occur in its waters, and with the exception of *U. rectus*, plentifully, but are not found any farther eastward. *U. compressus*, and *Alasmodonta rugosa*, western species, also occur in its vicinity, but have not been found east of the Green Mountains. *U. complanatus*, an eastern species, common as far at least as Eastport, Maine,* occurs abundantly in Lake Champlain. The family of Limnæana do not observe this boundary.†

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* Whence I have specimens, through the kindness of J. Ray, M.D. of that place.

† Of most of the species enumerated in this article, I have duplicates, and also of upwards of 100 marine species of the shells of Maine and Massachusetts, which I shall be happy to exchange for native or foreign shells.

Art. V.—*On the Means of detecting Arsenic in the Animal Body, and of counteracting its Effects;* by J. Lawrence Smith, M. D., of Charleston, S. C.

Messrs. Editors—This, I hope, will receive a place upon the pages of your Journal, if it be only for the importance of the subject of which it treats, although it is not improbable, in stating what I am about to do concerning the more recent experiments upon arsenious acid, that your readers will be able to find something which may be of importance to them in future investigations upon this substance. But two months have elapsed since the whole of France was agitated by one of the most interesting criminal processes upon record—it was a case of poisoning by arsenic; and the contradiction of the results of the medico-legal examinations, created an excitement which the decision of the jury augmented. Three chemical examinations were made upon different portions of the body, and at different times, to ascertain whether arsenic had been administered to the individual during life. The materials for the first were furnished immediately after death, and consisted of the fluid found in the stomach, the stomach itself, and a portion of the intestines; but the first was lost by an accident which happened to it while being experimented upon, so that the stomach and intestines alone remained. The second and third were made upon portions of the body exhumed after eight months' burial; they were the liver, heart, brain, and inner muscles of the thigh. The first and second examinations were made by several expert chemists of Tulle, without detecting the poison. The third M. Orfila was called upon to make, and he succeeded in exhibiting the metal, reduced by means of Marsh's apparatus; his success was no doubt owing to the manner in which he carbonized the animal matter, which was by the aid of nitric acid.

One cannot be surprised at the excitement that a thing of this character must have produced, and it is with much interest and benefit that I have followed up the chemical researches consequently arising, as well as the many interesting questions proposed for solution, and my object now is to mention the most important of them. Some of the questions are as follows:

1st. Does the hydrated peroxide of iron contain arsenic?

2d. Does arsenic exist normally in the animal tissues?

3d. Is not Marsh's apparatus subject to serious objections?

4th. What are the best means not only of detecting but of ascertaining the quantity of arsenic when in combination with animal matter?

5th. What are the best means of combatting the poisonous effects of arsenious acid?

To all these questions such answers will be given as have yet been furnished.

Does arsenic exist in the peroxide of iron?

This question originated from the fact that this substance had been administered in the case spoken of; and there are those who suppose that the arsenic detected belonged originally to the peroxide of iron used as an antidote.

It is well known that arsenic exists in a state of combination in many of the sulphurets of iron, from which the sulphate is obtained, and it is the latter that furnishes the peroxide either by precipitation or heat. Both forms of this oxide have been subjected to minute examination by M. Orfila, who was particularly interested in this question, and the following are his experiments with their results:

"1st. I boiled during four hours, in five capsules, four and a half ounces of hydrated peroxide of iron, taken from different apothecaries, with four ounces of distilled water, and by Marsh's apparatus no trace of arsenic could be obtained.

"2d. I then added thirty grains of pure caustic potash to the hydrated peroxide of iron in each capsule, but no trace of arsenic could be obtained.

"3d. But on treating by an ebullition of five hours an equal quantity of hydrated peroxide of iron in pure sulphuric acid, the liquid of three capsules out of the five gave arsenical taches.

"4th. Four portions of four ounces each of colcothar of commerce, (the anhydrous peroxide of iron formed by heating the sulphate,) obtained from different merchants, by ebullition for four hours in distilled water, did not give indications of the presence of arsenic.

"5th. This substance in the same quantity by ebullition during five hours with strong sulphuric acid, gave large arsenical taches with the aid of Marsh's apparatus.

"6th. Thirty grains of colcothar boiled with sulphuric acid, gave arsenical taches.

"7th. Fifteen grains of the same body, treated in the same way, gave no indications of arsenic.

"8th. A solution of sulphate of iron gave no arsenical taches with the apparatus."

M. Orfila next administered four ounces of colcothar to three dogs, tying the œsophagus to prevent vomiting. One of them was examined thirty four hours after, the second fifty, and the third sixty. The liver, spleen, heart, and kidneys of these animals, were submitted to investigation, but no trace of arsenic could be obtained. The liquid of the stomach and intestines of the first dog being separated from the colcothar, gave arsenical taches, though its urine did not indicate the presence of this metal. The intestinal liquid of the second dog gave some taches, less apparent and less numerous than that of the third, but on the contrary its urine gave strong indications of arsenic.

The conclusions to be arrived at from these experiments are, that the hydrated peroxide of iron, and the colcothar, the former of which is administered as an antidote for arsenious acid, contain arsenic in minute quantities, (though the former being no doubt as often without as with it,) but that it requires the aid of a strong acid to develope it, and also, that when these substances are administered, the arsenic that they contain is slowly absorbed, passes by the organs, and is eliminated by the urine. The organs never at any time retain sufficient arsenic to exhibit it when examined for.

This question being answered in the affirmative, would appear to throw a great obstacle in the way of pronouncing with certainty whether the arsenic found in the intestinal liquid of an individual supposed to have been poisoned, and to whom the hydrated peroxide of iron had been administered as an antidote, was due to arsenious acid or to the oxide of iron. This difficulty would not arise except the quantity found be extremely small; for the peroxide of iron, from the manner in which it is prepared, can contain but the smallest appreciable amount; and, moreover, as it has already been remarked, it is not always that we find even that. The plan that the medico-jurist should adopt, in a case of this character, would be to examine the peroxide of iron that the person had taken, should there be any of it remaining, if not the sulphate of iron from which it was made. Again, he should lay but little stress upon the examination of the intestinal liquid, but direct his attention particularly to the organs. This, together with circumstances peculiar to each case, will explain away any doubt that might arise.

It ought to be perfectly understood, that the fact of the peroxide of iron containing a small quantity of arsenic, should be considered rather as a light to guide the chemist in his researches, than as a stumbling-block that might cause him to fall into error.

Does arsenic exist normally in the animal tissues?

This perhaps has been one of the most interesting questions ever proposed to chemists, and the investigations that it has given rise to, serve to show the almost perfection of their science, for were it supposed that the whole animal frame contained but one fiftieth of a grain of arsenic, the chemist would not despair not only of being able to detect it, but also of fixing its locality.

As it regards the bones, it has been clearly demonstrated that they contain arsenic in a minute quantity, but sufficient to place the fact beyond the smallest doubt.

Whether it exists in the muscles or not, is a question by no means settled. It is true, that with the aid of Marsh's apparatus there can be obtained from muscles digested a long while in nitric acid, taches which are of different shades, such as brilliant white, brilliant yellow, and rusty color; they are volatile and not soluble in nitric acid. Many have supposed their composition to be sulphur with an infinitely small quantity of arsenic. I think that these taches can be more easily accounted for by sulphur and phosphorus, both of which exist in the muscles, and I am sorry that there is neither time nor opportunity to examine into the truth of this supposition. Nevertheless, whether they contain arsenic or not, the taches obtained have but one characteristic belonging to that of arsenic, volatility.

The next part of this question is very important; it is whether the organs, such as the liver, spleen, heart, &c., contain normal arsenic. The reason of its importance is, that it is upon them that we should place considerable reliance, in the examination of the body of a person supposed to have been poisoned by arsenic. To this we answer, that not the smallest trace has been detected in any of them; and the answer is based, not upon the few experiments of a single individual, but drawn from numerous careful researches, made by skillful chemists. What is still more convincing on this point, is, that even in some few cases, where an animal has been poisoned by arsenic, its liver will not indicate its presence.

To sum up the answer to this question in a few words—the bones do contain arsenic. No positive evidence has as yet been given to lead us to believe that the muscles contain the smallest quantity of arsenic. We have the most positive evidence that the organs do not contain the least trace of arsenic.

Is not Marsh's apparatus subject to many and serious objections?

This valuable instrument I think was discussed a year or two since, by Dr. Mitchell, of Philadelphia, but as I have never seen his article on the subject, I hope, that if this should meet his eye, he will excuse such parts of it as may be a repetition of what he then stated. Most that is about to be mentioned concerning this apparatus, belongs to the investigation of those more intimately connected with the subject than myself.

Marsh's apparatus, modified from its original and rather complex form, consists of a four or eight ounce phial, with a perforated cork and glass tube, bent at right angles, or straight, (the former is considered preferable, though in both instances the extremity must be drawn out to a capillary opening,) and furnished with a porcelain plate or saucer, and the materials for generating hydrogen—zinc, sulphuric acid and water. These three last substances in effect constitute the instrument. The first question to be decided is, whether any of them are subject to an impurity that might create an error.

As regards the zinc, that there are some instances of the zinc of commerce containing a small quantity of arsenic, is not to be denied; and that this will give rise to an impure hydrogen, when acted upon by pure sulphuric acid and water. But then, again, there is nothing more easy than to procure zinc of commerce which will generate hydrogen perfectly free from arsenic, notwithstanding there are some who say that purified zinc is not free from this metal; but it is evident that they must be mistaken, as any one may see by making the experiment, which, as it is a very simple one, it would be well to perform; and I feel confident in saying that little or no difficulty will be found in procuring ordinary zinc of the necessary purity to be used in Marsh's apparatus.

Sulphuric acid may contain arsenic, when manufactured with sulphur obtained from pyrites holding that substance in combination; but a simple distillation will serve to rid it of this impurity.

After placing the zinc, sulphuric acid and water in the apparatus, replace the cork with the glass tube inserted in it, and when the hydrogen has been allowed to generate a sufficient length of time to expel the air, inflame it as it issues from the extremity of the tube; if a porcelain plate be now applied to about the middle of the flame, and no tache or spot be obtained, we have the best evidence of the purity of our materials.

Another apparent objection to the apparatus, is, that the introduction of animal matter, either solid or liquid, causes the formation of a large quantity of froth, which arrests the progress of the operation. This, however, is so easily remedied, that it need hardly be considered an objection. If the froth be not in too great quantity, it will suffice to introduce a little oil, which will serve to arrest its formation. Another method is to turn the liquid out of the phial into a funnel, with the finger placed upon the lower extremity, the froth will at once rise to the surface, and by taking away the finger the liquid will pass out perfectly free from it. Again, if care be taken to carbonize the matter before using it, this obstacle will be removed. There is still another means, and I find it to succeed very well in most instances; it is to pour the sulphuric acid destined for the formation of the hydrogen first upon the animal matter, and then pour the two upon the zinc and water; it would appear that a partial carbonization takes place. No doubt most persons will now perceive that this objection possesses no weight, and vanishes altogether before the means proposed to encounter it.

The next part of this question to be examined, is, what substances besides arsenic produce taches with this apparatus, and is there no danger of confounding them with that of arsenic? They are antimony, sulphur, phosphorus and iron. Before speaking of their distinguishing characteristics, it would be as well to say a few words concerning that produced from arsenic.

The arsenical tache is highly metallic, of a steel color, with a slight reddish tinge, and borders of a dark rusty color; but to have a proper idea of its appearance, as well as that of the others, one should see them. It is volatile by heat, and is dissolved by cold nitric acid, which solution gives to the nitrate of silver a brick-red precipitate, the arsenate of silver.

The antimonial tache is less metallic than the former in its appearance, also blacker, and when very dense even smutty. It can be volatilized, but with great difficulty, and not before it has been as it were chased about the surface of the porcelain. It is soluble in cold nitric acid, which solution gives no red precipitate with nitric acid.

The next tache to be spoken of, is the compound one, of arsenic and antimony; at the same time mention will be made of the method adopted by M. Orfila for detecting the one or the other of these metals in it. It partakes, as might be expected, of the characters of both the metals that enter into its composition, being partially volatile, soluble in nitric acid, from which the brick-red precipitate of arsenate of silver can be obtained. M. Orfila proposes a plan of separating the constituents of this tache, and of testing each by itself. He proceeds as follows: having collected a number of the compound taches upon a porcelain plate, he dissolves them in nitric acid, which solution being poured into a capsule, is evaporated to dryness, and a residue remains composed of antimonious acid and a mixture of arsenic and arsenious acids. Upon this residue a little water is poured, and the capsule slightly heated, which enables the water to dissolve more readily the two last mentioned acids. The antimonious acid being allowed to settle, the clear liquid is decanted, and a few drops of nitrate of silver being thrown upon it, the brick-red arsenate of silver is formed, which is sometimes mixed with a considerable quantity of a yellow precipitate, the arsenite of silver. This will, however, rarely happen, if a large quantity of nitric acid has been used; for by so doing, only an extremely small quantity can remain in the state of arsenious acid, the oxidation being carried a degree higher. Nevertheless, if the entire precipitate produced by the nitrate of silver be yellow, it can have no effect in destroying the fact concerning the presence of arsenic, as it only indicates that it has met with arsenious and not arsenic acid. But to return to the substance left in the capsule:—A small quantity of muriatic acid, slightly diluted, is poured upon it, which immediately dissolves it. A current of sulphuretted hydrogen is now made to pass through this solution, when the orange-colored sulphuret of antimony is formed. Another process will be stated for arriving at the same end, when mention is made of a method by which I propose to separate arsenic from organic substances. The importance of studying this double tache will be evident to every reflecting mind, for it may not unfrequently happen that the physician called upon to administer to a person supposed to be laboring under the effects of arsenic, may use tartar emetic to disembarrass the stomach of the supposed poison; death taking place, an examination is made of the liquid found in the stomach and intestines, of urine, &c., by means of Marsh's apparatus, and a tache is obtained which is not easily volatilized, and which has the appearance of antimony. What then is to be done? Why, we are to proceed in our experiments as just stated, and the two metals, if both be present, are to be separated.

The tache from sulphur has all the characteristics of that substance; color yellow, volatile, with a suffocating smell, &c. There is not the least probability of confounding it with any thing else.

The tache from phosphorus possesses three different shades, brilliant white, brilliant yellow, and rust color. When the quantity of phosphorus is very small, either the first, or only the first and second are seen. It is volatile, reddens litmus paper, and is insoluble in cold nitric acid, so that there cannot be the least occasion for mistaking between this and arsenic.

The next substance that produces a tache when introduced into the apparatus in question, is iron, but it ought not to be classed with the others, for I am firmly convinced that it is not due to any iron that may be dissolved by the hydrogen; in other words that there is no ferruginous hydrogen. My reason for so believing is based upon the following facts:—If we desire to obtain this tache, a considerable quantity of iron, or some salt of iron, must be used, and the gas made to generate rapidly. Now observe what must take place. The action of the liquid being violent, a spray is formed, which consists of the dilute acid and whatever salts it may hold in solution, in this case iron as one; this spray passes along with the hydrogen through the jet; the hydrogen being now ignited, a porcelain surface is placed in contact with the flame, which, becoming heated, enables it to evaporate the water from the salt of iron, which deposits itself, and afterwards becomes decomposed by a continuation of the heat, the peroxide being left. If we still retain the iron in the apparatus, but make the action not very brisk, no tache will exhibit itself upon a smooth porcelain surface; but if the broken surface of a piece of porcelain is placed in contact with the flame, a slight black deposit is formed, consisting, as in the former case, of peroxide of iron; the reason of this is, that it is a more convenient surface for retaining the particles of the solution of iron thrown out in company with the hydrogen. Again, this tache is evidently an oxide, which it is not probable would be the case, had the iron been chemically combined with the hydrogen. Another reason is, that if the gas be made to traverse water or chloride of calcium before ignition, no tache will be formed, for the iron mixed with the hydrogen is retained by either of these means. This tache has been perhaps more noticed than it deserves. It is not easily produced, and is distinguished by its not being volatile and its solution in any of the strong acids, giving a blue precipitate with ferrocyanuret of potassium.

There is yet one other tache to be spoken of. If the flame of the apparatus, containing only zinc, sulphuric acid and water, be prolonged for some time upon one spot on the porcelain, an opake white tache will be perceived, which I propose to explain in the same way as the last, the cause of it being the oxide of zinc instead of iron, this oxide arises from the decomposition of a small quantity of sulphate of zinc thrown out with the hydrogen, but still it is a thing hardly worthy of notice, for after it is formed it is difficult to see it.

What is the conclusion to be arrived at concerning Marsh's apparatus, after what has been said? Why, that it should be considered as the most valuable instrument that the medico-jurist possesses, to assist him in his experiments upon the poison in question; for with proper care all the objections to it can be easily remedied, and the character of each tache is so well marked that they need never be confounded, as will be seen by glancing the eye over what follows.

Arsenic—Steel color, highly metallic, easily volatilized by heat, readily dissolved in nitric acid; the nitric acid solution gives with nitrate of silver a brick-red precipitate.

Antimony—Color darker than steel, metallic, with difficulty volatilized by heat, readily dissolved in nitric acid; the nitric acid solution gives with nitrate of silver no precipitate.

Sulphur—Color sulphur-yellow, easily volatilized by heat, not soluble in nitric acid, gives the well known smell of sulphur when burnt.

Phosphorus—Color brilliant from white to red, easily volatilized by heat, not soluble in nitric acid, reddens litmus paper.

Iron—Color black but slightly metallic, not volatilized by heat, soluble in nitric acid; the nitric solution strikes a blue color with ferrocyanuret of potassium.

Examination for arsenic in case of poisoning.

Under this head will be answered the fourth question, which is, What are the best means not only of detecting, but of ascertaining the quantity of arsenic in combination with animal matter?

Arsenious acid, it is well known, does not destroy life by a mere local action upon the stomach and intestines, as do many of the strong acids, but that its poisonous effects are exhibited after it has been absorbed into the system. It is true that it inflames the mucous membrane of the intestinal canal, but that is comparatively of minor importance to its other effects. If it be absorbed, in what secretions and in what organs is it to be found in the greatest abundance? The urine is the first secretion in which arsenious acid exhibits itself, and in that not long after administration. This fact, then, makes it important to preserve the urine of a person who we may suppose has been poisoned by this agent, for making the necessary medico-legal examination, and in cases where death does not occur it ought to be considered of more value than the matter vomited.

After the bladder, the liver and heart next demand our attention, for one may calculate with almost absolute certainty upon finding this substance in these organs, had it been employed. The brain and inner muscles of the thigh, in most cases of poisoning by arsenious acid, contain it in sufficient quantity to be exhibited by means of Marsh's apparatus. Other portions of the body frequently contain it in small quantities, but if we have the organs already mentioned, along with the stomach, intestines, and their contents, it will be all that it is important to experiment upon.

In commencing the experiments we should be furnished with the following materials, viz. nitric and sulphuric acids, nitrate of potash, zinc and water. Their purity should be fully established before they are employed.

The use of the nitric acid is to carbonize the animal matter, and in that way to develope any arsenic that it may contain. This process is of vast importance, as will be seen by the following example. Let the liver contain the largest quantity of arsenious acid that can reach it by the process of absorption, and it may be boiled for six hours, in distilled water, without giving up the smallest portion of the poison; whereas, carbonize it first by the aid of nitric acid, and then pour the water upon it, and results of an entirely different nature will be obtained. There are, no doubt, two reasons for the cause of this; the first is, that the arsenious acid has undergone some chemical change, which renders it insoluble; the second is, that the liver is completely broken up by the nitric acid, and the arsenic, in whatever state it may have existed, is now converted into arsenic acid. The nitrate of potash is sometimes employed to destroy the carbon after the nitric acid has acted upon the animal matter. The sulphuric acid, zinc and water, are the elements of Marsh's apparatus.

The fluid of the stomach and intestines should be first experimented upon; and this may be introduced into the apparatus either in its crude state, or after having undergone carbonization by heat or nitric acid. If it be employed uncarbonized, we may expect a great quantity of froth, which may be obviated in some measure by the means already mentioned. When we carbonize the matter by heat, it becomes necessary to introduce a small portion of pure caustic potash during its evaporation, which combines with arsenious acid, forming arsenite of potash, a substance not easily volatilized. If nitric acid be used, we first evaporate the liquid to dryness, then pour upon it two or three times its bulk of nitric acid, and again evaporate to dryness, when we may expect an almost complete destruction of the animal substances. The carbonized matter, formed either by heat or nitric acid, with whatever it may contain, is digested for a little while in pure water, which easily dissolves the arsenic, now in the states of arsenite of potash and arsenic acid. Filter, introduce the liquid into the apparatus, when we may expect to exhibit the metal upon a porcelain surface. In experimenting upon the urine, the same steps are to be taken.

The examination of the liver is conducted as follows:—Two or three pounds of it are first dried by a gentle heat, and then digested with about three times as much nitric acid by weight, until the mass becomes perfectly dry; water is now poured upon it, and heat applied for ten or fifteen minutes; the liquid is now filtered, and tested by the apparatus. The heart, muscles, brain, &c., if examined, must undergo the same process.

There is yet another advantage, that has not been mentioned, connected with the carbonization of animal matter by nitric acid; it is, that if antimony be present, it becomes converted into antimonious acid, which is insoluble in water.

Mention has been made only of the manner of separating arsenic from animal matter, by the aid of Marsh's apparatus, and it may be well to give a brief account of one or two new methods adopted by Mr. Persoz to serve the same end, with this additional advantage, that it enables one to ascertain the exact amount present.

The suspected materials, after having sufficient reason to suppose that they do not contain a poison of organic origin, or mercurial or antimonial preparations, are subjected to the action of dilute nitric acid, in order to destroy those parts that are decomposed by this agent. Most of the organic substances having undergone this decomposition, the residue is diluted with water, and heated to the boiling point, and then left to cool; the fatty and resinous substances rise to the surface, are taken off and washed, and the washings added to the original liquid, which is then evaporated to the consistency of syrup. The liquid now has a dark brown tint, an evidence that it still contains a quantity of organic matter. Nitric acid, therefore, is again added, and a new oxidation takes place. We recommence to evaporate, and continue to add nitric acid, until the liquid acquires a lively orange tint, when a careful evaporation is commenced, first over a naked fire, and then by the means of vapor. An approximate value being made of the quantity of residue, twice and a half times its volume of pure nitrate of potash is added, for the purpose of completing the oxidation. Water is next poured upon these materials, and heat applied and continued until the water is evaporated and the residue is dry; by this means an intimate mixture is brought about between the nitre and animal substances. In this part of the operation, care must be taken to extend the matter as much as possible over the surface of the capsule as soon as it begins to dry. The capsule is now heated almost to redness, when a deflagration takes place, and propagates itself through all the matter submitted to analysis, destroying all remains of organic matter. Care must be taken that the nitre be in sufficient quantity, for if not, this part of the process must be gone over a second time.

After the deflagration has taken place, it may be well to heat the residue a second time, in a capsule of platinum or silver, to redness. The residue consists generally of the following substances: the excess of nitrate of potash mixed with the nitrite of the same substance; carbonate of potash; the salts existing in the organic matter, as well as those formed during the process, such as the phosphates, sulphates and chlorides, free oxides, and finally arsenic acid, free and in combination with potash. This compound mass being pulverized, is mixed with one and a half times its bulk of hydrochlorate of ammonia, introduced into a retort, and heated to a dull redness. By the action of the heat, the chlorine of the hydrochlorate of ammonia combines with the potassium, and the hydrogen of the ammonia reduces the arsenic acid to the state of arsenious acid, which sublimes with the excess of hydrochlorate of ammonia, and is condensed on the upper part and neck of the retort. Other chemical changes take place, but they do not modify the one just stated. The operation being finished, the retort is broken, and the substance sublimed dissolved in water strongly acidulated with hydrochloric acid, and through this solution is passed sulphuretted hydrogen, which enables us to obtain all the arsenic that was originally in combination with animal matter, in the state of a pure sulphuret. This process is somewhat complicated, but each step is so clear, that with proper care, the most satisfactory result might be obtained in almost all cases.

In fulfilling the promise as regards the stating of all important facts lately brought to light concerning this too universal poison, I will mention two other methods of separating and of ascertaining the quantity of arsenic in combination with organic substances. They are both modifications of Marsh's apparatus; one is proposed by M. Lassaigne, and the other by myself.

M. Lassaigne, instead of igniting the arsenuretted hydrogen, and obtaining the arsenic upon a cold surface, passes it through a solution of nitrate of silver, which it has the property of decomposing. The solution first becomes brown, and then a deposit of oxide of silver takes place. After the gas has ceased to pass, a quantity of muriatic acid is poured upon it, which decomposes what nitrate of silver remains, and converts the precipitate into chloride of silver. There remains now in solution arsenic and arsenious acids, and by filtering and evaporating to dryness, they are obtained.

I propose to pass the arsenuretted hydrogen through a tolerably strong solution of iodine in alcohol, in order to decompose it, which it does effectually, there being formed the iodide of arsenic, which remains in solution. All that is now necessary to be done, is to evaporate nearly to dryness, until red fumes make their appearance, and then pour twice or thrice as much nitric acid as there is residue into the capsule. Heat is again applied, and the evaporation continued to dryness, when there will be remaining arsenic and arsenious acids. The nitric acid in this case converts the iodine of the iodide of arsenic, and the free iodine into iodous and iodic acids, both of which are evaporated with the undecomposed nitric acid.

Iodine also decomposes the antimoniacal hydrogen, first forming iodide of antimony, which the water of the alcohol immediately decomposes into hydriodic acid and oxide of antimony, the latter of which is precipitated. This then becomes a convenient mode of separating the two substances, antimony and arsenic, for by passing the compound gas through the alcoholic solution of iodine, it becomes decomposed, and iodide of arsenic is formed, which remains in solution, and the oxide of antimony which is precipitated, can be separated by means of a filter. This, however, is not the plan that I would propose; it would be better to invert the precipitate as well as the liquid into a capsule, evaporate and treat with nitric acid as in the case of arsenic, when we shall have left the arsenic, arsenious and antimonious acids, the two former of which are soluble in water.

One may now imagine that there is nothing easier for the medico-jurist than to form a correct opinion, and one that cannot be doubted, concerning the poisoning by arsenic. Whether such is the fact or not, he will find, in some cases, that all his skill and care will be required, not only to convince the minds of others, but even his own. It may not unfrequently occur, that arsenious acid has been the poisoning agent, and still great difficulties present themselves, which are enumerated in almost all works on medical jurisprudence.

There is one very important fact to be kept in mind with reference to examinations of this character; it is the medical treatment that the individual has been subjected to before death. For instance, the treatment by diuretics, which will be mentioned presently, may remove from one or more organs the poison previously contained in them, and still the impressions made upon them be too strong to be recovered from. How then is this difficulty to be removed? By carefully preserving all the urine—an observation which is of such importance that it should not escape the memory of any physician.

What are the best means of treating the poisonous effects of arsenic?

A few words upon two new methods of treating the effects of arsenic, will conclude this article, already extended much farther than I had intended.

The remedies that we already possess, are, at the very best, but feeble agents to combat the effects of this poison. The one most to be relied on is the hydrated peroxide of iron, it being a veritable antidote to poisoning by arsenic; however, there are some objections, the principal of which is the slowness of its absorption, for it is only where it encounters the poison that its salutary effects are displayed, by forming with it an inert arsenite of iron.

A treatment proposed in Italy, is the administration of stimulant draughts every two or three hours, consisting of brandy one ounce, wine two ounces, bouillon (the liquid produced by boiling beef or other meat in water) four ounces. It is based upon the supposition that the effects of arsenic are atonic, the truth of which is far from being established. Instances are given where this treatment has proved efficacious, although I have witnessed experiments made with it, in comparison with simply tepid water, where the latter proved to be the most successful of the two.

The treatment by diuretics is one that deserves some consideration; it is advanced by M. Orfila, based upon numerous experiments. It has been more than once stated, that the urine exhibits a large portion of the arsenious acid absorbed into the system, and it seems very rational to suppose, that if this secretion could be augmented by any means, that the quantity of arsenic carried off would be also increased. It has been observed, that where equal quantities of arsenious acid have been given to two dogs of equal vigor, and if one died and the other survived its effects, we find that the latter had urinated largely. The diuretics merit some attention; they are not to be used until the stomach is emptied of its contents by some mild emetic and tepid water.

In a medico-legal examination for antimony, most of the steps that have been proposed in the case of arsenic can be followed; the principal modification is where either nitric acid or heat has been used to carbonize the animal matter; for in that case, muriatic acid slightly diluted is to be employed as the dissolving agent instead of water.

Paris, December 6, 1840.

ART. VI.—*On the Extrication of the Alkalifiable Metals, Barium, Strontium, and Calcium; by* ROBERT HARE, M. D., Professor of Chemistry in the University of Pennsylvania.

Read before the American Philosophical Society, October 4, 1839.

IN the autumn of 1820, I devised an innovation in the mechanism and in the mode of completing the circuit of an *extensive* voltaic series. Previously to that time, in using any form of the voltaic battery, the circuit had always been completed by making a communication between the electrodes,* after the submersion of the plates. In the case of the deflagrator, the electrodes might be made to communicate before the immersion of the plates, the circuit being completed by their immersion. Or, in case the electrodes should not be in contact before immersion, the operator was enabled to bring them together so nearly about the same time, as to avail himself of the pre-eminently energetic action which immediately succeeds the encounter between the plates and the solvent.

Fourteen years had elapsed, during which I had the regret of perceiving that the advantages of the deflagrator were not sufficiently estimated in Europe, when, about the year 1835, the celebrated Faraday,† while investigating the principles upon which galvanic apparatus should be constructed, came to a conclusion

* Agreeably to the suggestion of Faraday, I use the word electrode, for the pole of a voltaic series; also anode, for the positive pole, and cathode for the negative pole.

† See London and Edinburgh Philosophical Magazine and Journal, vol. viii, for 1836, p. 114.

that the deflagrator eminently associated the requisites of which he was in search, and stated many facts and arguments tending to prove that it was the most perfect form of the apparatus at that time known. More than twelve years ago, while I was operating with a deflagrator of three hundred pairs, each seven inches by three, I observed that, in a circuit made through a saturated solution of chloride of calcium, by means of a coarse platina wire (No. 14,) and a fine wire, (No. 26,) that when the latter was made the cathode and the former the anode, a most intense ignition resulted, causing the rapid fusion of the fine wire into globules like common shot. But when the situations of the wires were reversed, so that the smaller wire was made to form the anode, the ignition became comparatively so feeble as to be incompetent to fuse the fine platina wire. This phenomenon had continued to appear inexplicable, when, during the last winter, it occurred to me that the evolution and combustion of the calcium might be the cause of the superior heat produced at the cathode.

This led to the employment of chlorides in the process of Seebeck, Berzelius, and Pontin, for the production of amalgams from the earths, in which a cathode of mercury, and anode of platina were used. Accordingly, in operating with a deflagrator of three hundred and fifty Cruickshank pairs of seven inches by three, a mercurial amalgam was speedily obtained, which appeared sufficiently imbued with calcium to become speedily buried under a pulverulent stratum of lime, and mercury in a minute state of division.

Nevertheless, after exposure of the amalgam thus produced to the air, till all the calcium had been separated, and igniting the resulting powder to drive off the adhering mercury, the ratio of the weight of the lime thus obtained, to the mercury with which it had been united, was not over a five hundredth part. With a view to procure an amalgam in which the proportion of calcium should be greater, I was led to devise the following apparatus and process, of which an engraving and description are now laid before the society.

How far the result of my exertions, subsequently stated, may be considered in advance of the steps previously taken, will be evident from the fact that all the knowledge which exists, respecting the isolation of the metals of the alkaline earths, is due to the experiments and observations of Davy ; and to what point they extended may be learned from the following quotations from the Bakerian lectures of that celebrated chemist. In reference to his efforts to isolate the radical in question, the distinguished lecturer mentions "that to obtain a complete decomposition was extremely difficult, since nearly a red heat was required, and that at a red heat the bases of the earths acted upon the glass, and became oxygenated. When the tube was large in proportion to the quantity of amalgam, the vapor of naphtha furnished oxygen sufficient to destroy a part of the bases; and when a small tube was employed, it was difficult to heat the part used as a retort sufficiently to drive the whole of the mercury from the base without raising too highly the temperature of the part serving for a receiver so as to burst the tube." "When the quantity of amalgam was about fifty or sixty grains, I found that the tube could not be conveniently less than one-sixth of an inch in diameter, and of the capacity of about half a cubic inch. In consequence of these difficulties, in a multitude of trials, I had few successful results; and in no case could I be absolutely certain that there was not a minute portion of mercury still in combination with the metals of the earths."*

The observations are more than confirmed by my experience, which leads me to the conviction that the removal of the mercury is not to be accomplished thoroughly in glass vessels, and, of course that Davy was perfectly correct in supposing that the products which he described as barium and strontium, were alloys with mercury. I am also under the impression that the metals above mentioned decompose naphtha, when heated with its vapor, and enter into combination with its constituents. Had the barium which Davy obtained, been free from mercury, it would not have been fusible below a red heat, as alledged by him. Agreeably to my experience, that metal requires no less than a good red heat for its fusion.

In a subsequent paragraph he adds: "The metal from lime I have never been able to examine exposed to air or under naphtha. In the case in which I was enabled to distil the mercury from it to the greatest extent, the tube unfortunately broke while warm, and at the same moment when the air entered the metal, which

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* See Transactions of the Royal Society, Part II. Nicholson's Journal, vol. xxi, for 1808; or, Tilloch's Philosophical Magazine, vol. xxxiii.

had the color of silver, took fire and burnt, with an intense white light, into quicklime."*

Had the failure of Sir Humphrey, in his efforts to isolate calcium, been due only to the accidental fracture of a glass tube, it would be inexplicable that a chemist so indefatigable should not have successfully reiterated the experiment; or that no other chemist, during thirty intervening years, should have succeeded by resorting to the same means. No doubt exists in my mind that without using a larger quantity of mercury than the sixty grains which he employed, and resorting to other materials than glass for a distillatory apparatus, no chemist could succeed in the isolation of calcium, nor in the complete distillation of the mercury from the amalgams of the other metals, so as to obtain available quantities for examination.

In a subsequent communication to the Royal Society, Davy mentions, that "by passing potassium through lime and magnesia, and then introducing mercury, I obtained solid amalgams, consisting of potassium, the metal of the earth employed, and mercury."

"The amalgam from magnesia was easily deprived of its potassium by water." Of the amalgam containing calcium he makes no farther mention, but suggests the possibility of obtaining, by operations performed in this manner, quantities of the metals of the earths sufficient for determining their nature and agencies.†

But I will proceed to explain and describe the apparatus and process to which I have resorted, and to communicate the results which I have obtained.

A Description of the Apparatus and Process for obtaining amalgams of Calcium, Barium, and Strontium from saturated solutions of their Chlorides, by exposure to the Voltaic circuit in contact with mercury.

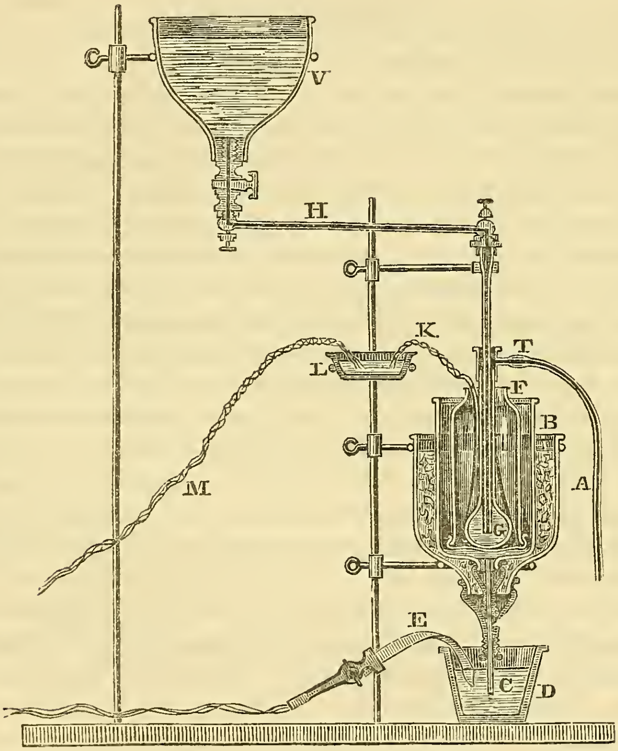
A and B, two bell glasses, with perforated necks, were inverted and placed one within the other, so that, between them, there was an interstice of half an inch, which was filled with a freezing mixture. Concentrically within B a third similar bell F,

* See Transactions of the Royal Society, Part II. Nicholson's Journal, Vol. xxi, for 1808; or, Tilloch's Philosophical Magazine, Vol. xxxiii.

† Transactions Royal Society for 1810, part I, p. 62. Tilloch's Magazine, vol. xxxvi, p. 87.

was placed, including a glass flask, of which the stem extended vertically through the neck of F. From a vessel V, with a cock intervening, a tube luted to the orifice of the flask extended to the bottom of it, so as to convey thither from V a current of ice-water, which, after refrigerating the bulk of the flask, could escape through the nozzle projecting, horizontally, from the neck, T. The mercury in the capsule D communicates through the rod with the negative poles of one or more deflagrators. The capsule L in like manner with the corresponding positive poles.

Fig. 1.



A rod of platina reaches from some mercury in the capsule D, through the necks of the beds A and B, into a stratum of mercury, resting upon shoulder of the bell glass B, so as to be about a quarter of an inch beneath the flask. Several circumvolutions of platina wire, No. 14, forming a flat coil, were interposed between the mercury and the bottom of the flask. The recurved ends of this wire were made to reach into the mercury in the capsule L. Over the mouth of the bell F, after the introduction of the flask and coil, some bed-ticking was tied, so as to prevent contact between the platina and mercury, and to check as much as possible, any reunion between the radical taken up by the one, and the chlorine liberated by the other. Into the bell T, a saturated solution of the chloride to be decomposed was poured, and some coarsely powdered crystals of the same compound added. Of course the solution, by penetrating the ticking, came into contact with the mercury.

Electrolytic Process.

The peculiar mechanism of my apparatus, by which, in ten seconds, the acid may be thrown *on* or *off* of the plates, enables the operator, within that time, after a due arrangement of the poles is made, to put either or both of the deflagrators in operation, or to suspend the action of either or both. This mode of completing or breaking the circuit gives a great advantage in deflagrating wires ; or in the processes, wherein dry cyanides, phosphurets, or carburets are to be exposed to voltaic action in vacuo, or in hydrogen. It enables us to arrange every part of the apparatus so as to produce the best effect upon the body to be acted upon, and then to cause a discharge of the highest intensity of which the series is capable, by subjecting the plates to the acid previously lying inactive in the adjoining trough.

In the case in point, where a chloride was to be decomposed, the deflagrators could be made to act through the same electrodes, either simultaneously or alternately. Of these facilities I thus availed myself:

Having supplied each deflagrator with a charge of diluted acid of one fourth of the usual strength, I began with No. 1, and at the end of five minutes superseded it by putting No. 2 into operation. Meanwhile, having added to No. 1 as much more acid as at first, at the end of the second five minutes, I superseded No. 2 by No. 1; and in like manner, again superseded No. 1 by No. 2. Having thus continued the alternate action of the deflagrators for about twenty minutes, both were made to act upon the electrodes simultaneously, the balance of acid requisite to complete the charge having been previously added.

By these means the reaction was rendered more equable than it could become in operating with one series more highly charged. Although, under such circumstances, the reaction may, at the outset, be sufficiently powerful to produce ignition, as I have often observed, after fifteen or twenty minutes it may become too feeble in electrolyzing power to render the continuance of the process in the slightest degree serviceable. Agreeably to my experience, as the ratio of the calcium to the mercury increases, the amalgam formed becomes so much more electro-positive as to balance the electro-negative influence of the voltaic current. After reacting with one series of two hundred pairs, of one hundred square inches each, for seventy minutes, I have found the proportion of calcium to be only one six-hundredth of the amalgamated mass obtained.

In this lies the great difficulty of obtaining any available quantity of the radicals of the alkaline earths by electrolyzation; especially in the case of calcium. It is easy, by a series of only fifty pairs, to produce an amalgam with that metal, which, when exposed to the air, will become covered with a pulverulent mixture of lime and mercury; but, in such case, the quantity of calcium taken up by the mercury, when estimated by the resulting oxide, will be found almost too small to be appreciated by weighing. To increase the quantity of calcium to an available extent I have found extremely difficult, since, as the process proceeds, the chemical affinity becomes more active, while the electrolyzing power becomes more feeble.

That a change should be effected in mercury, giving to it the characteristics of an amalgam, by the addition of a six hundreth part of its weight, cannot be deemed difficult to believe, when it is recollected that Davy found that when, by amalgamation with ammonium, a globule of mercury had expanded to five times its previous bulk, it had gained, in weight, only one twelve thousandth part.*

As the affinity between the chlorine and the radicals of the alkaline earths increases in strength with the temperature, and as heat is evolved in proportion to the energy of the voltaic action, the disposition of the elements separated by electrolyzation to reunite is, in this way, promoted. Hence the necessity of refrigeration.

* Sixty grains of mercury contained only one two hundredths of a grain. See Nicholson's Journal, Vol. XXXIII, p. 213.

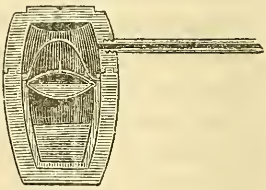
The best index of the success of this process is the evolution of chlorine; since in proportion to the quantity of this principle extracted at the anode, must be the quantity of calcium separated at the cathode. During my operations, chlorine was evolved so copiously as to tinge the cavity of the innermost bell with its well known hue. Hence, when the evolution of chlorine ceases to be very perceptible, the amalgam should be extricated from the apparatus, and separated by a funnel and the finger from the solution of chloride, and immediately subjected to distillation.

It has been mentioned, that in the electrolytic process above described I resorted to the alternate action of two deflagrators. This was effected by making the negative poles of both communicate with the mercury in capsule D, while the positive poles communicated with some mercury in capsule L. For a description of the deflagrators employed, I refer to the American Philosophical Transactions, vol. v, or to this Journal, vol. xxxii, p. 285, as those which I employed were of the kind there described.

I have found great benefit to arise from Mr. Sturgeon's expedient of amalgamating the surfaces of the zinc; which Faraday has represented as giving, to a great extent, the properties of a sustaining battery. Agreeably to my experience, it renders the plates less liable to be encrusted with suboxide of zinc and copper, which always impairs the energy of a voltaic series.

Distillatory Apparatus and Process.

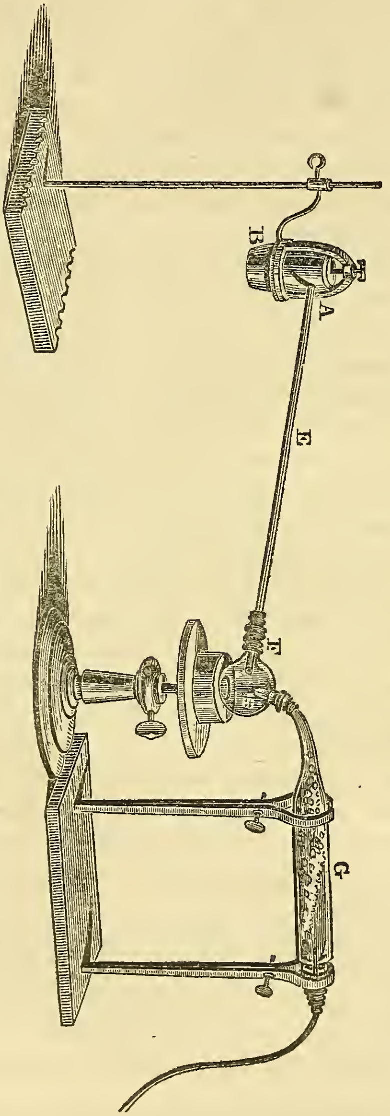
Fig. 2.



A quantity of the amalgam, weighing about three thousand grains, was introduced into an iron crucible. Of this crucible a section is represented by Fig. 2, which was forthwith closed by a capsule seated in a rabbet, or groove, made on purpose to receive it. The capsule being supplied with about half a dram of caoutchouchine, was then covered by the lid. In the next place, by means of a movable handle, or bail, of wire so constructed as to be easily attached, the crucible was transferred to the interior of the body of the alembic, A. Into the cavity thus occupied, about a dram measuse of naphtha was poured. The canopy, A, and body of the alembic, B, were then joined, (as represented in Fig. 3,) with the aid of a luting of clay and borax between the grooved juncture, and the pressure of the stirrup screw provided for that purpose.

A communication was made between the alembic and a small tubulated glass receiver, by means of an iron tube thirty inches

Fig. 3.



long, and a quarter in bore. The tubulure of the receiver received the tapering end of an adopter, G, which communicated with a reservoir of hydrogen by means of a flexible lead pipe. The length of the tube prevented the alembic, or receiver, from being subjected to the agitation which results from the condensation of the mercurial vapor. Before closing the juncture completely, all the air of the alembic was expelled by a current of hydrogen, desiccated in its passage by a mingled mass of chloride of calcium and quicklime contained in the adopter. By keeping up the communication with the reservoir of this gas, while subjected to a column of about an inch or two of water, the pressure within the alembic being greater than without, there could be no access of atmospheric oxygen.

The bottom of the alembic was protected by a stout capsule of iron, (a cast iron mortar, for instance.) The next step was to surround it with ignited charcoal, in a chauffer or small furnace, taking care to cause the heat to be the greatest at the upper part. By these means, and the protection afforded by the mortar, the ebullition of the mercury may be restricted to the part of its mass nearest to the upper surface. Without this precaution, this metal is liable to be thrown into a state of explosive vaporization, by which it is driven out of the crucible, carrying with it any other metal with which it may be united.

On the first application of the fire, the caoutchouchine distilled into the receiver. Next followed the naphtha from the body of the alembic. Lastly, the mercury of the amalgam distilled; the last portions requiring a bright red heat, in consequence of the affinity between the metal and the alkalifiable radical.

After the distillation was finished, the apparatus having been well refrigerated, the alembic was opened and the crucible removed. As soon as the lid was taken off, some naphtha was poured between the rim of the capsule and sides of the crucible, so as to reach the metal below. This was found adhering to the bottom of the crucible.

When the heat was insufficient to carry off all the mercury, the metal was found in a state somewhat resembling metallic arsenic in texture, though its susceptibility of oxidation, and its affinity for carbon, caused it to be deficient of metallic lustre, until the surface was removed by the file or burnisher.

Properties of the Metals obtained by the processes above mentioned.

Either metal was rapidly oxydized in water, or in any liquid containing it; and afterwards, with tests, gave the appropriate proofs of its presence. They all sank in sulphuric acid; were all brittle and fixed; and, for fusion, required at least a good red heat. After being kept in naphtha, their effervescence with water is, on the first immersion, much less active. Under such circumstances they react, at first, more vivaciously with hydric ether than with water, or even chlorohydric acid; because in these liquids a resinous covering, derived from the naphtha, is not soluble, while to the ether it yields readily.

By means of solid carbonic acid, obtained by Mitchell's modification of Thilorier's process, I froze an ounce measure of the amalgam of calcium, hoping to effect a partial mechanical separation of the mercury by straining through leather, as in the case of other amalgams. The result, however, did not justify my hopes, as both metals were expelled through the pores of the leather simultaneously, the calcium forming, forthwith, a pulverulent oxide, intermingled with, and discolored by mercury in a state of extreme division.

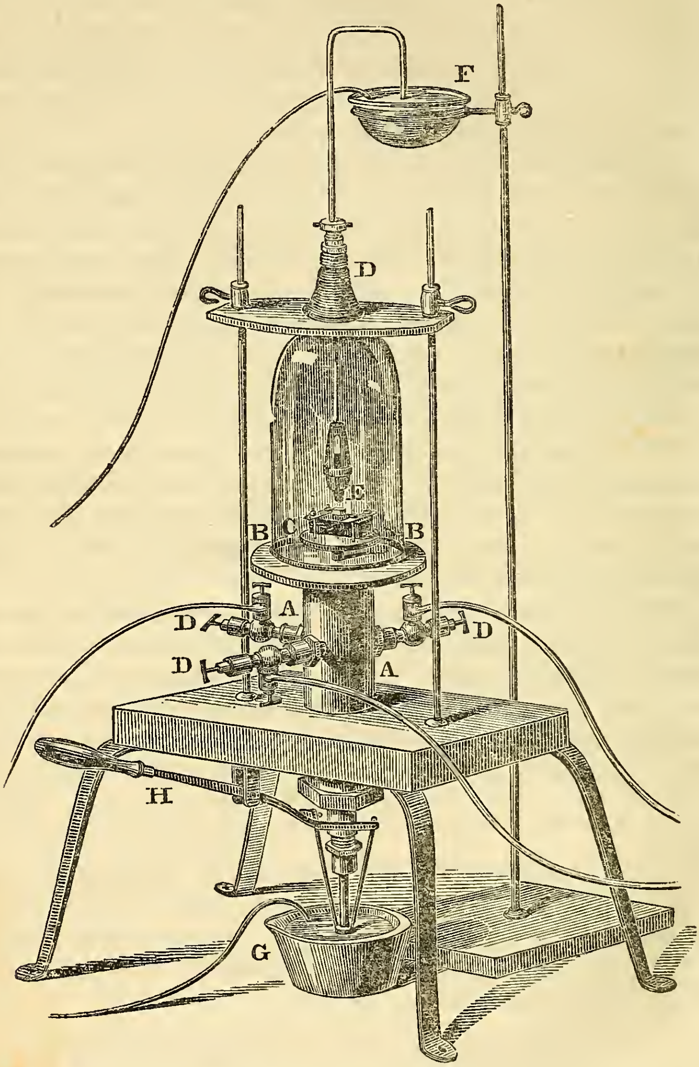
By the same means I froze a mass of the amalgam of ammonium as large as the palm of my hand, so as to be quite hard, tenacious and brittle. The mass floated upon the mercury of my mercurial pneumatic cistern, and gradually liquefied, while its volatile ingredients escaped.

When the freezing of the amalgam was expedited by the addition of hydric ether, the resulting solid effervesced in water, evolving ethereal fumes. This seems to show that a portion of this ether may be incorporated with ammonium and mercury, without depriving the aggregate thus formed of the characteristics of a metallic alloy.

Art. VII.—*Description of an Apparatus for Deflagrating Carburets, Phosphurets, or Cyanides, in vacuo or in an Atmosphere of Hydrogen, with an account of some Results obtained by these and by other means; especially the Isolation of Calcium;* by Robert Hare, M. D.

Read before the American Philosophical Society, October 18, 1839.

Upon a hollow cylinder of brass (A A) an extra air-pump plate (B B) is supported. The cylinder is furnished with three valve cocks, (D D D,) and terminates at the bottom in a stuffing-box, through which a copper rod slides so as to reach above the level of the air-pump plate. The end of the rod supports a small horizontal platform of sheet brass, which receives four upright screws.



These, by pressure on brass bars extending from one to the other, are competent to secure upon the platform a parallelopiped of charcoal. Upon the air-pump plate a glass bell is supported, and so fitted to it by grinding, as to be air-tight. The otherwise open neck of the bell is also closed air-tight by tying about it a caoutchouc bag, of which the lower part has been cut off, while into the neck a stuffing-box has been secured air-tight. Through the last mentioned stuffing-box a second rod passes, terminating within the bell in a kind of forceps, for holding an inverted cone of charcoal, (E.)

The upper end of this sliding rod is so recurved as to enter some mercury in a capsule, (F.) By these means and the elasticity of the caoutchouc bag, this rod has, to the requisite extent, perfect freedom of motion.

The lower rod descends into a capsule of mercury, (G,) being in consequence, capable of a vertical motion, without breaking contact with the mercury. It is moved by the aid of a lever, (H,) connected with it by a stirrup working upon pivots.

Of course the capsules may be made to communicate severally with the poles of one or more deflagrators. The substance to be deflagrated is placed upon the charcoal forming the lower electrode, being afterwards covered by the bell, as represented in the figure. By means of the valve-cocks and leaden pipes a communication is made with a barometer gage; also with an air-pump, and with a large self-regulating reservoir of hydrogen.

The air being removed by the pump, a portion of hydrogen is admitted and then withdrawn. This is repeated, and then the bell glass, after as complete exhaustion as the performance of the pump will render practicable, is prepared for the process of deflagration in vacuo. But, if preferred, evidently hydrogen or any other gas may be introduced from any convenient source by a due communication through flexible leaden pipes and valve-cocks.

Having described the apparatus, I will give an account of some experiments, made with its assistance, which, if they could have illuminated science as they did my lecture room, would have immortalized the operator. But, alas, we may be dazzled, and almost blinded by the light produced by the hydro-oxygen blow-pipe, or voltaic ignition, without being enabled to remove the darkness which hides the mysteries of nature from our intellectual vision.

I hope, nevertheless, that some of the results attained may not be unworthy of attention; and that, as a new mode of employing the voltaic circuit, my apparatus and mode of manipulation will be interesting to chemists.

An equivalent of quicklime, made with great care from pure crystallized spar, was well mingled, by trituration, with an equivalent and a half of bicyanide of mercury, and was then enclosed within a covered porcelain crucible. The crucible was included within an iron alembic, such as has been described by me in this volume, as employed for the isolation of metallic radicals. (See page 300.)

The whole was exposed to heat approaching to redness. In two experiments the residual mass had such a weight as would result from the union of an equivalent of cyanogen with an equivalent of calcium.

A similar mixture being made, and, in like manner, enclosed in the crucible and alembic, it was subjected to a white heat. The apparatus being refrigerated, the residual mass was transferred to a dry glass phial with a ground stopper.

A portion of the compound thus obtained and preserved was placed upon the parallelopiped of charcoal, which was made to form the cathode of two deflagrators of one hundred pairs, each of one hundred square inches of zinc surface, co-operating as one series.

In the next place, the cavity of the bell-glass was filled with hydrogen, by the process already described, and the cone of charcoal being so connected with the positive end of the series as to be prepared to perform the office of an anode, was brought into contact with the compound to be deflagrated. These arrangements being accomplished, and the circuit completed by throwing the acid upon the plates, the most intense ignition took place.

The compound proved to be an excellent conductor; and during its deflagration emitted a most beautiful purple light, which was too vivid for more than a transient endurance by an eye unprotected by deep-colored glasses. After the compound was adjudged to be sufficiently deflagrated, and time had been allowed for refrigeration, on lifting the receiver, minute masses were found upon the coal, which had a metallic appearance, and which, when moistened, produced an effluvium, of which the smell was like that which had been observed to be generated by the silicuret of potassium.

Similar results had been attained by the deflagration, in a like manner, of a compound procured by passing cyanogen over quicklime, enclosed in a porcelain tube heated to incandescence.*

Phosphuret of calcium, when carefully prepared, and, subsequently, well heated, was found to be an excellent conductor of the voltaic current evolved from the apparatus above mentioned. Hence it was thought expedient to expose it in the circuit of the deflagrator, both in an atmosphere of hydrogen and in vacuo. The volatilization of phosphorus was so copious as to coat nearly all the inner surface of the bell-glass with an opake film, in color resembling that of the oxide of phosphorus, generated by exposing this substance under hot water to a current of oxygen.†

The phosphuret at first contracted in bulk, and finally was, for the most part, volatilized. On the surface of the charcoal, adjoining the cavity in which the phosphuret had been deflagrated, there was a light pulverulent matter, which, thrown into water, effervesced, and, when rubbed upon a porcelain tile, appeared to contain metallic spangles, which were oxydized by the consequent exposure to atmospheric oxygen.

In one of my experiments with the apparatus above described, portions of the carbon forming the anode appeared to have undergone complete fusion, and to have dropped in globules upon the cathode. When rubbed, these globules had the color and lustre of plumbago, and, by friction on paper, left traces resembling those produced by that substance. They were susceptible of reaction neither with chloro-hydric nor with nitric acid, neither separately nor when mixed. They were not in the slightest degree magnetic.

About 1822, Professor Silliman obtained globules, which were at first considered as fused carbon, but were subsequently found to be depositions of that substance transferred from one electrode

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* After the above mentioned experiments were made, I was led to believe that the compound, obtained as above described by heating lime with bicyanide of mercury, contained fulminic acid, or an analogous substance. The mass being dissolved in acetic acid, and the filtered solution subjected to nitrate of mercury, a copious white precipitate resulted. This, being desiccated, proved to be a fulminating powder. It exploded, between a hammer and anvil, with the sharp sound of fulminating silver.

† The compound usually designated as the phosphuret of calcium consists, according to Thomson, of one atom of phosphate of lime, as well as two atoms of pure phosphuret. Hence it is easy to see that the oxygen which enters into the constitution of the oxide, deposited, as above mentioned, upon the interior surface of the bell-glass, is derived from the phosphate.

to the other. Several of these globules were, by him, sent to me for examination, of which none, agreeably to my recollection, appeared so much like products of fusion as those lately obtained.

Formerly plumbago was considered as a carburet of iron, but, latterly, agreeably to the high authority of Berzelius, has been viewed as carbon holding iron in a state of mixture, not in that of chemical combination. It would not, then, be surprising if the globules which I obtained consisted of carbon converted from the state of charcoal into that of plumbago.

Art. VIII.—*Abstract of the Proceedings of the Tenth Meeting of the British Association for the advancement of Science.*

The tenth meeting of this body was held at Glasgow, during the week commencing on the 16th of September, 1840. From the report published in the London *Athenæum*, is prepared the following abstract, in which, on account of our limited space, we are obliged to omit some details, which are less within the scope of this Journal.

The number of members at this meeting, was 1353, viz. new members, 995; old life members, 121; old annual members, 107; foreigners, 40. The property of the Association is £5895 1*s.*; the year previous it was £6588 0*s.* 4*d.*; the reduction being caused by the large grants paid during the year, for scientific uses. These payments amount to £1548 4*s.* 4*d.*

At the general meeting on Thursday evening, Sept. 17, Mr. Murchison read the report of the General Secretaries, in which was presented a brief view of what the Association had effected during the past year, as recorded in the last published volume of their transactions.

Professor Whewell was elected President of the Association, for the coming year. The next meeting will be at Plymouth, the precise time to be fixed by the Council, after consulting the local authorities.

Sect. A. *Mathematics and Physics.*

Major Sabine presented his *Report on the translation of foreign memoirs.* At the meeting at Newcastle, in 1838, a committee was appointed to procure and publish translations of foreign scientific memoirs, and the sum of £100 was placed at their disposal; and at the meeting in 1839, a further sum of £100 was allotted for the same object. The memoirs translated in the first year, under the superintendence of the committee, and at the expense of the Association, were :—

1. 'Remarks on the advancement of magnetical observatories, and a description of the instruments to be placed in them,' (with one plate) by Weber.
2. 'Method to be pursued during the magnetical term observations,' by Gauss.
3. Extract from the daily observations of magnetic declination, during three years at Göttingen, by Gauss.
4. Description of a small portable apparatus for measuring the absolute intensity of terrestrial magnetism, (with one plate) by Weber.
5. 'On the graphical representation of the magnetic term observations,' (with two plates) by Gauss.

For the translation and publication of these in Taylor's *Scientific Memoirs*, the first year's grant of £100 was paid to Mr. Taylor. In the present year, Ohm's memoir, entitled 'The galvanic circuit investigated mathematically,' has been translated at the expense of the Association, and given to Mr. T. for the 7th and 8th Nos. of the *Scientific Memoirs*. The Association have also paid for seven plates, representing the lines of magnetic declination, inclination, and intensity, computed by M. Gauss's theory. Translations of the eight memoirs below mentioned, have been gratuitously presented to the committee :—

1. Gauss 'On a new instrument for the direct observation of the changes of the intensity in the horizontal portion of the terrestrial magnetic force.'
2. Weber 'On the arrangement and use of the bifilar magnetometer.'
3. Gauss, 'General theory of terrestrial magnetism.'
4. Encke 'On the method of least squares.'
5. Bessel 'On the determination of the axes of the elliptic spheroid of revolution which most nearly corresponds to the existing measurements of arcs of the meridian.'
6. Weber, 'Description and use of a transportable magnetometer.'
7. Bessel 'On the barometrical measurement of heights.'
8. Rudberg, 'Experiments on the expansion of air.'

These translations have been placed by the committee, in the hands of Mr. Taylor, by whom they have been printed in the 6th, 7th, and 8th Nos. of the *Scientific Memoirs*.

Revision of the Nomenclature of the Stars.—Report of a committee appointed in 1838, consisting of Sir J. Herschel, and Messrs. Whewell and Baily. The revision of the northern hemisphere and the constellations visible in Europe, has been continued by Mr. Baily, by carefully tracing the just and most authentic limits of the existing and recognized constellations, and by a careful examination of the several stars, in the course of which many singular instances of confusion and error in naming and placing have been detected. This process, which involves an investigation of the history of each star, and of the designations it has received from each of its observers, and in the several catalogues in which it occurs, is nearly complete, and may be considered as clearing the ground for a systematic nomenclature of the northern stars, as well as for an effective table of synonyms of each star. In the southern hemisphere, or rather in those constellations which are visible only to an observer in that hemisphere, Sir John Herschel has continued, and nearly completed, a chart of *those stars only*, and of *all those stars* which are distinctly visible to the naked eye in a clear night; in which chart each star is represented of its true magnitude, according to a scale, in which the total interval from the stars of the first magnitude, to the lowest inserted, in place of six degrees, is made to consist of eighteen, so as to subdivide each magnitude into three. The final assignment of these magnitudes, resting on the collation and inter-comparison of an extensive series of observations, made for that express purpose with the naked eye, occasionally assisted by a common opera glass, has been a work of much time and labor, and is not yet quite completed. Nor till this is accomplished, can any further progress be made in the arrangement of the southern constellations, which at present are in a state of great confusion. A small part only of the grant of £50, has been expended, but the whole, will, no doubt, be required; and your committee therefore recommend its continuance.—Signed for the Committee, J. F. W. Herschel.

On the Reduction of the stars in Lacaille's Cœlum Australe Stelliferum, the committee report, that the reductions of all the stars are finished; and Mr. Henderson's assistant is at present arranging the results in the form of a catalogue, which however, could not be completed in time for this meeting. The completed portion, so far as finished, has been transmitted to Mr. Baily, to be used in the construction of the new catalogue of the Astronomical Society. No money has been spent during the year; but of course, a renewal of the grant will be desirable.—Signed for the committee, J. F. W. HERSCHEL.

Report on the reduction of Meteorological Observations made at the equinoxes and solstices, on the part of a committee appointed in 1838.—Sir J. Herschel, referring to his report of last year for the reasons why the reduction of these observations was not immediately commenced, reports further that the same reasons delayed any effective commencement of the work until very lately; but that owing to several wanting series of observations having at length come to hand, so as to render the series for the years 1835–8 tolerably consecutive, at least for several localities, your Committee considered it advisable to wait no longer, but proceed to work with the materials in hand. Accordingly, having cast the plan of operations for the comparison and projection of the barometric oscillations in those years, (to which for the present, your Committee propose to limit their proceedings, till it shall appear whether a further and more complete comparison, including the thermometric changes, and especially the correspondence of the winds, seems likely to lead to any valuable conclusions,) the reduction, arrangement and projection of the several series of observations was confided to the able and zealous hands of W. R. Birt, Esq., who is now actively employed in this operation, and who has enabled your Committee to lay before the meeting, as specimens of the mode of proceeding, the tabulation and projection of the observations made in the British Isles in the year 1836, which are, accordingly, submitted for inspection. In the discussion of these observations, it has been found advantageous to divide the stations from which they have emanated, into groups, according to geographical proximity, the chief of which are,—the group of the British Isles, that of the continent of Europe, the North American, South African and Indian groups. Each of these groups is referred, by applying the differences of longitude to the times of observation, to a central station; and the projected curves, in which the abscissæ are the mean times at that station, and the ordinates the reduced barometric altitudes, exhibit at one view the correspondence or disagreement of the barometric movements for all the stations of the group. * * * The projection of these curves is the first step in the process of reduction contemplated; and even in the very limited range afforded by the specimens now presented, affords ground for interesting remark. Thus we see that the march of the barometer in the only two Irish stations which have furnished observations, (Markree and Limerick,) while agreeing well with each other, differs most decidedly from its corresponding march in all the English stations; which, on the other hand, offer a good correspondence, *inter se.* * * It would be premature, at present, to enter fully into the details of the further steps contemplated in these reductions, as they will be, of necessity, materially influenced by the aspect under which the subject shall present itself in its progress, and especially by the discussion of one or two of the most complete series, among which, thanks to American zeal and industry, the group including the United States promises to be the most prominent. Only a very trifling sum (under £2,) has been hitherto expended (for the printing of the skeleton forms,) out of the original grant of £100; but the continuance of the grant will be required to meet the further requisite expenses. It is only justice to Mr. Birt to observe, that his part of the work appears to be executed with great care and judgment.—Signed, J. F. W. Herschel.

Reduction of the stars in Lalande's Histoire Céleste.—The Committee appointed to superintend the reduction of stars in the *Histoire Céleste*, report, that about 33,000 stars have been already reduced, the cost of which has been about £412, exclusive of about £52 for printing skeleton forms for the use of the computer. They further report, that there are about 16,000 more stars to be reduced, the cost of which will be about £200 more. As the original grant will not cover the whole of this expense, (there being only about £35 remaining out of that grant,) the Committee suggest the propriety of extending the grant for the ensuing year to the £200 above mentioned, which, they trust, will complete the work. Aug. 25, 1840.—Francis Baily.

Catalogue of Stars of Roy. Ast. Soc.—The Committee appointed to superintend the extension of the Royal Astronomical Society's Catalogue of Stars, report, that the work is in considerable progress, and that it will probably be completed before the next meeting of the British Association, in 1841. They further report, that £360 have been already paid for computations, and about £70 for printing and other expenses, making a total of about £430, out of the original grant for £500. As this balance of £70, will not be sufficient to complete the work, the Committee request that it may be extended to £150, which they hope will meet every expense.

Report on Radiant Heat.—Prof. Whewell laid before the Section an abstract of Prof. Powell's Report on Radiant Heat. This report was supplementary to one furnished by Prof. P. to the Association at the Oxford meeting in 1832, and he now proposed to give an account of the progress of discovery since that period. Such a report was peculiarly required from the number and importance of the results arrived at in the interval, which though not sufficient to form the basis of an unexceptionable theory, have at least tended greatly to modify previous opinions, and to enable us to refer large classes of phenomena to something like a simple and common principle. The former report was divided into various heads, derived from what appeared in the then existing state of our knowledge, well-marked distinctions between several kinds of effects ascribed to radiant heat; but recent discoveries have in a great degree so changed our views on the subject, that these divisions cannot with any advantage or convenience be adhered to. One principle of arrangement, however, has been newly supplied in the discovery of the polarization of heat; so that all the researches to be described may be conveniently classed under two heads:—1st, as they relate to heat in its *ordinary* or *unpolarized* state; 2dly, as they relate to *polarized* heat. The report then entered on the first general head, by calling attention to the recent researches of Melloni and Forbes respecting the *transmission* and *refraction* of heat. Prof. P. adverted to the discovery of Melloni, that the resistance to the passage of heat is *not* exerted at the surface, but at the interior of the mass. This was a result of the observation, that the difference between the transmission of heat from a more highly heated source and from a less highly heated source, became less as the thickness of the screen was diminished, and disappeared when very thin screens were interposed. By comparing the transmissive powers of a great number of substances, he found that in crystallized bodies the diathermaneity for the rays of a lamp was proportional to their refractive powers; but in uncrystallized bodies no such law could be traced. It was in the course of these researches that Melloni made the important discovery of the singular property possessed by rock-salt,—viz. that it is almost entirely permeable to heat, even from non-luminous sources. He found its transmissive power six or eight times greater than that of an equal thickness of alum, which had nearly the same transparency and refractive power; and that, unlike other diathermanous media, it is *equally* diathermanous to every species of heat, i. e. whether from sources highly heated or moderately heated; thus, he found a plate of 7 millimetres (.28 inch) thick, to transmit 92 out of 100 rays, whether from flame, red hot iron, water at 212°, or at 120° F. A plate one inch thick gave a similar constant ratio: the general conclusion resulting, that the source being a lamp, the diathermancy is not proportional to the transparency; and he makes some general remarks on these results, as related to those of Seebeck, on prismatic dispersion. In a supplementary paper, Melloni investigates the modifications which calorific transmission undergoes in consequence of the radiating source being changed. He employs four sources of heat:—1, a Locatelli lamp; 2, incandescent platinum; 3, copper heated by flame to about 730° F.; 4, hot water in a blackened copper vessel. The discovery of the complete diathermancy of rock-salt furnished the means of prosecuting the author's researches on the refraction of heat. In the successful experiment which he made, he concentrated in the focus of a rock-salt lens, the rays of dark heat from hot copper and hot water. A similar lens of alum produced no effect, which proves that the effect is not due to the mere heating of the central part of the lens. In discussing the properties of the calorific rays transmitted by different bodies, a remarkable effect presented itself; the rays of the lamp were thrown upon screens of different substances in such a manner that, either by changing the distances, or by concentration with a mirror or a lens of rock-salt, the effect transmitted from all the sources was of a certain constant amount. This constant radiation was then intercepted by a plate of alum, and it was found that very different proportions of heat were transmitted by the alum in the different cases; from which Melloni concludes, "that the calorific rays issuing from the diaphanous screens are of different qualities, and possess (if we may use the term,) the *diathermancy* peculiar to each of the substances through which they have passed." He next investigated the effects of *colored glasses*, and concludes that all the colored glasses except green, produce no 'elective action' on heat; green glass, on the contrary, transmits rays more easily stopped than the others; and that green glass is the only kind which possesses a coloration for heat, (if we may use the term,) the others acting upon it only as more or less transparent glass of uniform tint does upon light. From experiments upon the solar rays transmitted by green glass, and intercepted by other media, he found they passed copiously through rock-salt, but feebly through alum: whence he concludes that there are among the solar rays some which resemble those of terrestrial heat; and in general, that the differences observed between solar and terrestrial heat, as to their properties of transmission, are therefore to be attributed merely to the mixture, in different proportions, of these several species of rays. Prof. Forbes repeated and extended Melloni's experiments on the transmission and refraction of heat. One of the most interesting points to which he directed his attention, was the possibility of detecting heat in the moon's beams. These, concentrated by a polyzonal lens of 32 inches diameter, and acting on the thermo-multiplier, gave no indication of any effect: so that Prof. F. considers it certain that if there be any heat, it must be less than the 300,000th part of a degree centigrade. In his third section, he investigates the index of refraction for heat of different kinds as compared with that for light in the same medium. The method of observation adopted was indirect, depending upon the determination of the critical angle of total internal reflection in a rock-salt prism with two angles of 40°, and one of 100°. By an ingenious mechanical contrivance, the sentient surface of the pile was made to receive rays coming from the source of heat after undergoing two refractions and one reflection, whatever was the angle of incidence. The mean of the results obtained from various sources of heat, variously transmitted, for the index of refraction for rock-salt, is 1.552. The results deduced are:—1. The mean quality, or that of the more abundant proportion of the heat from different sources, varies within narrow limits of refrangibility. 2. These limits are very narrow indeed where the direct heat of any source is employed. 3. All interposed media, (including those impermeable to light,) so far as tried, *raise* the index of refraction. 4. All the refrangibilities are inferior to that of the mean luminous rays. 5. The limits of dispersion are open to further inquiry, but the dispersion in the case of sources of low temperature, appears to be smaller than that from luminous sources.

The report then went on to the researches of Melloni on the reflection of heat; and the analogies of light and heat, as traced by Forbes and Melloni. He dissents from the opinion of Ampère, that the difference between heat and light is to be accounted for by the difference of wave length on the undulatory hypothesis. During these researches, he found that a certain kind of green glass colored by oxide of copper, though it permitted a portion of luminous rays to pass, absorbed all the calorific rays, so that it exhibited no calorific action capable of being rendered perceptible by the most delicate thermoscope, even when so concentrated by lenses, as to rival the direct rays of the sun in brilliancy. With respect to the transmission of heat by screens, Prof. F. remarked that Melloni's view of the transmission of heat of low temperature, by all substances alike, is equivalent to saying that substances in general allow only the more refrangible rays to pass, or that while rock-salt presents the analogy of white glass, by transmitting all rays in equal proportions, every substance hitherto examined acted on the calorific rays as violet or blue glass does on light, absorbing the rays of least refrangibility, and transmitting the others only. To this rule, Melloni made out the first exception, or the first analogue to red glass,—rock-salt with its surface smoked. Prof. F. soon pointed out another, viz. mica split by heat into numerous fine laminæ, and hence, as the effect was obviously mechanical, (since unlaminated mica produces no such effect,) he concludes that the smoked surface of the rock-salt acted also mechanically, and was thus led to try the effects of surfaces variously altered by mechanical means; and thus effects in some distant degree analogous to *sifting* the heat, were observed. Fine powders, also sifted on the surface, were found to affect the transmission of heat, and these Prof. F. considered analogous to diffraction and periodic colors in light. From these important researches, we have learned to connect modifications in the transmission of heat with the quality of refrangibility, and not as heretofore with a supposed difference of quality depending on the *source* of the heat. The report then gave an account of the researches of Dr. Hudson on radiation of heat, those of President Bache and Stark on the influence of color and surface on radiation, and Prof. P.'s experiments upon the repulsive power of heat; and adverted to Mr. Farquharson's theory of the formation of ice at the bottom of rivers, as a result from radiant heat. From this opinion, Prof. P. dissents. The report then proceeds to the second division, on *polarized heat*, under which a detailed history of the several successive discoveries of Prof. Forbes on this subject was minutely given, with the dates of the several stages of the discoveries. Melloni having failed in repeating the experiments of Berard in polarizing heat by the tourmalin, and Nobili having in vain attempted it by reflection, Mrs. Somerville, in her *Connexion of the Physical Sciences*, 2d ed., speaks of it as altogether without experimental proof. In November, 1834, Prof. Forbes took up the subject and obtained complete success. He succeeded in polarizing heat from various sources, and by the aid of various substances, as piles of plates of mica, and by reflection and refraction, and showed that the peculiar modification of the experiments adopted by Berard, by reflection from glass, the quantity even at the maximum which could reach the thermoscope after two reflections, would be so extremely small, as that no difference of effect in the two rectangular positions could really have been perceptible. The entire series of those discoveries was completed between November, 1834, and January, 1835, the main practical improvement (which led to all the rest of the discoveries,) being the employment of the piles of mica. Prof. Forbes being at Paris in the summer of 1835, and finding both Biot and Melloni sceptical as to these results, he exhibited them to those philosophers with mica piles, which he prepared for the occasion, and which he left with Melloni. The next subject entered upon by Prof. F. was that of circular and elliptic polarization. This he determined both by depolarization, and also by the internal reflection of heat in a rhomb of rock-salt, as in the analogous cases of circular polarization of light. The report then adverted to the researches of Melloni on polarized heat, and entered minutely into historical details, and the theoretic views of the author; and then pointed out some expressions in Dr. Thomson's work on heat, which might lead a person who did not carefully attend to dates and facts, to attribute the priority of discovery to Melloni, and thus to deprive Prof. Forbes of a portion of his well-earned fame; and which was so clearly his due, that in 1836 the Keith prize had been awarded to him by the Royal Society of Edinburgh, after a close examination by the council of the researches and experiments; and subsequently the Rumford medal was adjudged to him by the Royal Society of

London, after similar precautions. The later researches of Forbes and Melloni on this subject, related to the connexion of these discoveries and the facts thus developed, with the undulatory theory. The report contained some remarks on the clearness with which the chronological order of the discoveries is marked in this case, and the consequent impossibility of any of those disputes which have sometimes tended to disturb the harmony of scientific inquiries. The continental philosophers have the merit of devising and bringing to perfection the instrument, by the aid of which alone, any discoveries in this very delicate field of research could have been expected. Prof. Forbes is the author of the discovery of the polarization of heat in all its branches, and from all its sources.

Prof. Forbes gave an abstract of his *Supplementary Report on Meteorology*. At the last meeting of the Association, he had been requested to make a report on the progress of meteorology since the period of his former report, which was drawn up in 1833. In obedience to that request he now came before them. He had distributed the matter of this report under the same general heads as those under which he had formerly treated of the several subjects. These were Temperature, Pressure, Humidity, Wind, Clouds, Rain, Electricity, Meteors, and suggestions on the first of these heads. In the report he had entered fully into the subject of the instruments used for measuring temperature, with their improvements, defects, and the cautions to be observed in using them. He enlarged on the decrease and accumulation of heat, and the curves which were used for elucidating these subjects. He spoke of the temperature decreasing in a geometrical series as you ascend through arithmetically increasing heights, the temperature being supposed constant, and entered on an examination of the paradoxical conclusion at which Poisson had arrived, that the upper surface of the atmosphere was, in consequence of the extreme cold there existing, in a state which he termed liquefaction. He observed that there are reasons for concluding that the temperature of space itself entirely beyond the atmosphere of the earth, was not so cold as Poisson seemed to suppose the highest portions of our atmosphere ; but that, independent of this opinion, there were other causes in operation quite sufficient to limit the extent of the atmosphere, without the aid of this startling supposition, and which limited height might be considered as almost established, since Wollaston's proofs derived from the two entirely unconnected sources of astronomical and chemical phenomena. He then glanced briefly at the subject of isothermal lines, and passed on to the subject of solar radiation. He examined at great length the researches of Poisson on this subject; and pointed out what he considered the inadequacy of his speculations on what may be called the astronomical part of the total influence. The chief point insisted on in this branch, was, the neglect of Poisson to take into calculation the influence of the earth's atmosphere in diminishing the heating power of the sun's rays, particularly when they entered it obliquely. This he showed to be most important, by stating the fact, that at Paris the influence of the atmosphere upon rays entering vertically, was to reduce their heating influence by 25 per cent. of what it would have been had they not passed through it; when they entered so obliquely as to form an angle of 25° with the horizon, their heating influence was reduced to one half; and when an angle of 5°, to one twentieth part. If Poisson's views were correct, the total solar influence at Paris would be 24° centigrade; and as the mean temperature of Paris is 11°, this would leave about 13°, or about 9° of Fah., as the temperature irrespective of the sun's heat; whereas the mean temperature of the polar parts of the earth, which are so far from being totally deprived of solar influence, that they are alternately under that influence and deprived of it, is no higher than about 32°. He then proceeded to the consideration of the temperature of the earth below the surface,—gave a sketch of the results of former experiments, originating in those made in the caves under the Observatory at Paris; detailed the results of those lately made; and promised, before the meeting was closed, to bring up this subject again, in connexion with the experiments made at Edinburgh. Then he glanced rapidly at the subject of mean temperature, and showed, that while within the tropics it is sufficient to plunge a thermometer a foot under the surface of the earth, in order to get by its mean indication the mean temperature of the place, in higher latitudes this would not be sufficient; and he detailed the circumstances producing the difference, and pointed out the methods and precautions necessary for obtaining it. He then entered on the consideration of the temperature of the space beyond the earth, and stated the probable source of it to be the radiating influence of the stars. Under the head of *pressure*, the barometer, its construction and proper use, came under consideration. He pointed out the use of curves in recording and comparing its indications,—the great variety of its oscillations in the several parts of the earth, and the importance of accurate registers of its indications being kept,—alluding to the value of the hourly observations recorded, for so many years, under the inspection of Mr. Snow Harris, at Plymouth, and those at Leith and other places in Scotland, under the inspection of Sir D. Brewster. He next referred to a fact which seems to lead to the inference, that we must repose less confidence in the barometer as a means of measuring heights than has been heretofore supposed. It has been found by actually leveling between the Black Sea and the Caspian, that the latter is only 82 feet below the level of the former; whereas barometric measurements, founded on previous determinations, since carefully repeated, gave, in consequence of some unknown anomaly, the difference of 320 feet. The *humidity* of the atmosphere was the next topic discussed. As to the amount of vapor in the air, at any one instant, he considered that by the researches of Dr. Apjohn, begun at the suggestion of the Association, the important problem of the wet-bulb thermometer had been completely solved, and meteorologists thus put in possession of a simple and most effective instrument. The distribution of humidity in the atmosphere was next noticed. Under the head of *wind*, he alluded to the theory of Dove, which he said was comparatively unknown in these countries; and briefly spoke of the researches of Lieut. Col. Reid, Mr. Redfield, and Mr. Espy. Passing over the topics of *clouds* and *rain*, he promised to bring forward on a future day, some facts connected with extraordinary falls of rain which had been observed; but which, as stated by him, in one instance in his former report, had been in his absence called in question. Regarding *electricity*, he observed that little had been added either to our instrumental resources, or to our knowledge of the subject, since his former report. On the subject of *meteors*, the report contained all the recent information concerning the unusually numerous appearance of those which had been seen for some years, on the 12th and 13th of November, and 10th of August; and concluded by pointing out the advantages of public meteorological observations for the purpose of, 1st. determining laws: 2d. keeping, and under proper regulations suffering to be inspected, standard instruments: 3d. making and recording observations, in number and with a regularity not to be expected, and scarcely ever obtained, in observatories maintained by individuals. Private stationary observations were next noticed, and suggestions thrown out; and lastly, traveling observations.

A report was then read, on the application of a portion of the sum of £50, voted in 1839, for discussion of *tide observations*, and placed at the disposal of Rev. W. Whewell. The subject has been diligently prosecuted during the year, and is still in progress.

Sir David Brewster gave in his report on the *hourly meteorological observations* made at Kingussie, (N. lat. 57°; W. lon. 4°,) and at Inverness, (N. lat. 57° 29½′; W. lon. 4⅕°.) Having selected Inverness and Kingussie as two suitable stations for carrying out two series of hourly observations with the thermometer and barometer, and having prevailed upon Rev. Mr. Rutherford, of Kingussie, and Mr. Thomas Mackenzie, of Inverness, to undertake the observations, the necessary instruments were made by Mr. Adie of Edinburgh, under the superintendence of Prof. Forbes, and the observations begun Nov. 1, 1838, that month being the commencement of the meteorological year, or the first of the group of winter months. I have now the satisfaction of laying before the Association the observations themselves, forming two quarto volumes,—a work of stupendous labor, executed for the first time, by educated individuals, with the aid of properly instructed assistants. The observations made at Kingussie, and to a certain extent those made at Inverness, contain ampler details of meteorological phenomena than any series of hourly observations with which we are acquainted. In addition to the thermometrical observations, the height of the barometer, and the temperature of the mercurial column were observed every hour. The general character of the weather was carefully noted. The character and direction of the wind at every hour was recorded. The number of hours of wind, of breeze, of calm, of rain, of snow, and of cloudy and clear weather, were regularly marked; and the number and nature of the auroræ boreales were recorded and described. When these observations are compared with those made at Leith under my superintendence for four years, with those made at Plymouth from 1832 to 1840, at the expense of the Association, and under the able superintendence of Mr. Snow Harris, and with those made at Padua, Philadelphia and in Ceylon, we perceive very distinct traces of meteorological laws, of which no idea had been previously formed; and I have no hesitation in stating that when observations of this class are multiplied and extended, they will lead to general results of as great importance in predetermining atmospherical changes, as those which have enabled the astronomer to predict the phenomena of the planetary system. * * In comparing the number of hours of calm throughout the year, it appears that they occurred when the temperature was lowest, and upon laying them down in a curve, this curve was almost exactly the reverse of that of the mean daily temperature of the year; that is, the wind, or commotion in the atmosphere, depends on and varies with the temperature. This very important and new result is confirmed in a remarkable manner by the observations of Mr. Osler at Birmingham; observations of inestimable value, which were made at the request and expense of the British Association, and exhibit more important results respecting the phenomena and laws of wind than any which have been obtained since meteorology became one of the physical sciences.

Comparative force of the wind during the twenty-four hours. Mr. Follett Osler brought forward a paper in which he gave the results of his investigations respecting the direction and force of the wind, deduced from the mean of 26,000 hourly observations, taken by the anemometer at the Philosophical Institution at Birmingham, during 1837, 8 and 9. In tabulating these observations, the curve obtained is found to be almost identical with that of the thermometer; not only for the whole year, but for each season. The increase in the temperature, however, precedes the rise of the wind by a short interval, until it has attained its maximum force; but as evening approaches, the wind declines more rapidly than the temperature.

Mr. Caldecott made a communication respecting an *Hourly register of Meteorological observations kept at Trevandrum*, commenced June 1, 1837, and to be continued to June 1, 1842. The observatory was erected by the Rajah of Travancore, in lat. 8° 30′ 35″ N.; lon. 5*h.* 8*m.* E. of Greenwich; 170 feet above the level of the sea, and distant from it in a direct line, about two miles. Every precaution appears to have been taken to insure accuracy, and of the observers, (all natives of India,) Mr. C. remarks that after the first difficulty of instructing them is surmounted, their patient, diligent and temperate habits peculiarly fit them for the office here required of them, and I have always found those who have been selected for the duty full as trustworthy as any class of persons probably, to whom such observations are usually intrusted. For the two years ending June 30, 1838, the mean temperature of the station was 78°.79 : the mean dew point 71°.78. The barometric registers give, by a mean of all the diurnal semi-oscillations, the following results:

Fall	between	10 A. M. and 4 P. M. . .	.109 inch.
Rise	"	4 P. M. and 10 A. M. . .	.108 "
Fall	"	10 A. M. and 4 A. M. . .	.071 "
Rise	"	4 A. M. and 10 A. M. . .	.073 "

Times of *maxima*, between the hours of 9 and 10 morning and evening. Times of *minima*, between those of 3 and 4 afternoon and morning.

Mr. Scott Russell read the report of the *Committee on Waves.* All the objects confided to this committee, (consisting of Sir John Robinson and himself,) having been fully accomplished, the report now presented was to be considered as final. That part of the duties of the committee which related to the connexion of the phenomena of waves with the resistance of fluids to solids, had devolved upon them under a separate name, as the committee on *forms of vessels*, and would be reported under a separate head. The wave form of vessel, however, had been now proved to possess so many advantages, that its use seemed likely to become general, and thus a great change would be effected in naval architecture. Prof. Kelland read a communication on the theory of waves.—Sir D. Brewster communicated a paper on Prof. Powell's measures of the indices of refraction for the lines G and H in the spectrum ; and Prof. Powell one on an experiment of interference of light.

On a blue sun seen at Bermuda. Sir D. Brewster communicated a letter from Lieut. Col. Reid, governor of the Bermudas, covering a letter from Dr. A. W. Harvey, of Bermuda, who states that on the 11th and 12th August, 1831, immediately after a hurricane which devastated Barbadoes, the sun appeared of a bluish color, and its light was unusually dim. This was owing, as Sir D. Brewster imagined, to the interposition between the sun and the observer, of vapor or water in a vesicular state. Col. Reid's letter also contains the following statement: "Three days ago (i. e. Aug. 14, 1839) I had a fine opportunity of observing a water-spout under my house, and could with a spy-glass distinctly observe, that *at the surface of the sea* it was revolving like the hands of a watch, and the same observation was made at a telegraph station near the government house. This is the fifth account, well authenticated, in north latitude: all five revolved the same way."

On the decomposition of glass, by Sir D. Brewster.—There is no subject more curious or more instructive than the disintegration of crystallized and uncrystallized bodies, either by the direct influence of chemical agents, or the slow process of natural decomposition. At the meeting at Edinburgh, I submitted, (said Sir D.) a brief account (since enlarged and published in the Edinburgh Transactions,) of remarkable optical phenomena produced by the instantaneous action of water and other fluids on crystals, and on their subsequent decomposition when placed in their saturated solutions. Since that time I have had occasion to examine the phenomena of decomposed glass, both of that which is found in Italy, and of specimens recently found in making excavations among the ruins of the Chapter-house of the Cathedral of St. Andrews. In decomposed glass, the decomposition commences in points, and extends itself either in planes so as to form thin films, or in concentric coats so as to form concentric films. When the centres of decomposition are near each other, the concentric films or strata which they form interfere with each other, or rather unite, and the effect of this is, that the glass is decomposed in films of considerable irregularity, their surfaces having a finely mammillated appearance convex on one side and concave on the other. The films thus formed, afford by transmitted light colors of infinite beauty and variety, surpassing any thing produced in works of art. They have the effect of dissecting, as it were, the compound surface of the solar prism, or of sifting and separating the superimposed colors, in a manner analogous to what is produced by colored and absorbing media. I have succeeded indeed, in producing one or more bands of white light incapable of decomposition by the prism; and there can be no doubt that they will be found to exercise a similar or an analogous action on the leading rays of the thermometric spectrum. In the decomposed glass from St. Andrews, a change of a very different kind is effected. In some cases the siliceous and the metallic elements of the glass are separated in a very singular manner, the particles of silex having released themselves from the state of constraint produced by fusion and subsequent cooling, and arranged themselves circularly round the centre of decomposition; while the metallic particles, which are opake, have done the same thing in circles alternating with the circles of the siliceous particles. This restoration of the silex to its crystalline state, is proved by its giving the colors of polarized light, and possessing an axis of double refraction. The most valuable glass articles manufactured by Fraünhofer, of Munich, seemed to be peculiarly liable to some superficial decomposition of this kind. A prism of this glass in the Observatory of Paris had become absolutely black. A prism belonging to himself had become quite blue on the surface, although as yet its action on light was not affected. The largest object glass of the principal telescope in the Observatory of Edinburgh had begun to show decided symptoms of superficial decomposition, and many other instances could also be mentioned. M. Lamont, professor of astronomy at Munich, who is in the constant habit of using Fraünhofer's glasses, stated that there is an easy and effectual remedy for this tendency of Fraünhofer's glass to deteriorate on the surface, which was to rub it frequently with the finer parts of whiting, prepared by elaborating a mass of whiting in water, the fine powder to be dried and used on old soft linen.

On the *rings of Polarized Light produced in specimens of decomposed glass;* by Sir D. Brewster.—In the course of a series of experiments on the connexion between the absorption of light and the colors of thin plates, published in the Phil. Trans. 1837, I accidentally observed under the polarizing microscope, certain phenomena of polarized tints of great beauty and singularity. These tints were sometimes linear and sometimes circular, and in some specimens they formed beautiful circular rings traversed by a black cross, resembling the phenomena of mineral crystals, or those produced by rapidly cooled circular plates or cylinders of glass. Having found in the decomposed glass from St. Andrews, that the siliceous particles had resumed their position as regular crystals, and arranged themselves circularly round the centre of decomposition, I was led to suppose that this was the cause of the phenomenon, and that the rings were the effect of the double refraction of the minute crystals. A few experiments, however, overturned this hypothesis, and I was soon satisfied, by a little further investigation, that the phenomena arose wholly from the polarization of the transmitted light by *refraction*, the splendid colors being entirely those of thin plates, which were sometimes arranged so as to have the appearance of concentric rings. The structure by which these effects was produced, was compared by the author to a heap of very deep watch glasses laid one above another. When the thin films were arranged longitudinally, and were inclined to the general surface of the plate, so as to transmit the rays obliquely, the light was still polarized, but only in one plane, viz. a plane perpendicular to the plane of incidence. When a drop of *water* or *oil* was introduced between the films, the phenomena of *polarization* as well as of color, instantly disappeared.

Prof. Phillips communicated *new experimental researches on rain.* He had endeavored, by a new train of researches on the quantities of rain received on horizontal surfaces, at different heights above the ground, and by a contemporaneous series of experiments on the direction and angle of inclination of the descending lines of rain drops, and by contemporaneous registration of wind, temperature and moisture, to furnish additional data of importance in the theory of rain. In the second part of his communication he described a new rain-gauge, for the purpose of determining the direction in which rain comes, and the angle of inclination at which it descends. For this object, a compound gauge is constructed, having five equal receiving funnels and tubes; one with a vertical tube and horizontal aperture, the other four with tubes recurved, so as to present the openings of the funnels in four vertical planes, directed to four quarters of the horizon.

Excessive rain.—Prof. Forbes remarked that some doubt had been expressed concerning the remarkable fall of rain at Genoa (not Geneva,) stated in his report of the previous year, viz. 30 inches in 24 hours, Oct. 25, 1822. He now adduced satisfactory proof of its truth. He then noticed some other remarkable falls of rain. Flaugergues, the eminent meteorologist of Viviers, obtained, on the 6th of September, 1801, 14½ English inches of rain in eighteen hours. On the 20th of May, 1827, there fell at Geneva, six inches of rain in three hours. At Perth, Aug. 3d, 1829, there fell 4-5ths of an inch in half an hour. Don Antonio Lago observed at San Luis, Maranham ($2\frac{1}{2}^{\circ}$ S. lat.) a fall of 23 feet 4 inches 9.7 lines in a year.

Mr. Espy's paper *on Storms*, which excited much attention, was appointed for half past twelve o'clock, (Sept. 19,) and that hour having now arrived, the President called on Mr. Espy, who commenced by stating that he had found by examining simultaneous observations in the middle of storms, and all round their borders, that the wind blows inward on all sides of a storm towards its central parts; towards a point if the storm is round, and towards a line, if the storm is oblong, extending through its longest diameter. Mr. Espy stated that he had been able to investigate within the last five years seventeen storms, without discovering one exception to the general rule. He could now only give a specimen of the manner in which he had proceeded. He presented a map of Great Britain, on which were drawn arrows representing the course of the wind on the night of January 6th, 1839. From this and from documents which Mr. Espy proceeded to read, it appeared that during those hours the wind was blowing a violent gale on the northwestern part of the island from the N. W.; on the southwestern parts from the S. W., and on the southeastern parts a strong gale from the S. E. and S. S. E.; and that in the middle parts of the island it changed from southeasterly to southwesterly about those same hours:—the change taking place about two hours sooner on the west side of the island than on the east side in the central parts, but much sooner in the northern parts than in the southern. The barometer also fell sooner in the northern and western parts than in the southern and eastern. From these two circumstances he thinks it highly probable, that this storm moved not exactly toward the east, but a little south of east, and if so, it would be similar to some storms which he had examined in the United States. He mentioned one in particular, which occurred January 26, 1839, whose N. N. E. and S. S. W. diameter reached at least seven hundred miles, while its diameter from W. N. W. to E. S. E. was probably not more than 300. The south border of this storm certainly travelled towards the south of east, and Mr. Espy found that in this storm, as in many others, the barometer fell sooner to the north and west than to the south and east. A much greater difference however depended on the longitude than on the latitude of places. The barometer was at its minimum at Cape Wrath, in the N. N. W. corner of Scotland, two hours and a half sooner than at the Calf of Man, five hours sooner than at Edinburgh, and thirteen hours and a half sooner than at Thwaite, in Suffolk. Mr. Espy then stated that he had examined the data furnished by Col. Reid, of several hurricanes in the West Indies, and found conclusive evidence that the wind blew inwards to a central space in all these storms. Diagrams of two were exhibited :—one on the 3d of October, 1780, in which Savannah-la-Mar was destroyed. In that storm, at its very height, the wind at Savannah-la-Mar, on the south side of the island of Jamaica, was south,—and nearly opposite to that point, on the north side of the island, the wind was N. E., or nearly in an opposite direction, for two hours at the time of the greatest violence of the storm at both places. The other storm was on the 18th of August, 1837, off Charleston, S. E. On that day, the ship *Duke of Manchester* had the centre of the storm pass over her, and on the same day, the *West Indian* and the *Rawlins*, which were on the southwest of the *Duke of Manchester*, had the wind all day from 2 A. M. southwest, and at the same time the *Cicero* and the *Yolof*, on the N. E. of the Duke of Manchester, had the wind N. E. and E. N. E. The *Yolof* all day, till 8 P. M. Mr. Espy then stated that he had visited the tracks of eighteen tornadoes, and examined several of them with great care, and found that all the phenomena told one tale,—the inward motion of the air to the centre of the inverted cone of cloud as it passed along the surface of the earth. From all these facts he demonstrated that there is an inward motion of the air towards the centre of storms from all sides; and that this is the inference which ought to be drawn from the well-known fact, that the barometer stands lower in the midst of a storm than it does all round its borders. The difficulty is, to account for the continued depression of the barometer, notwithstanding the great rush of air at the surface of the earth towards the place where the barometer stands lowest. So great did this difficulty appear to Sir J. Herschel that he stated to the British Association at Newcastle, that it appeared to him fatal to Mr. Espy's theory. It appeared to Sir John that the only way to account for the fall of the barometer was a centrifugal force in the air, arising from the whirlwind character of storms. Mr. Espy thought it probable that the following statements had never met the eye of Sir John, or he would at least have hesitated before he gave it as his opinion, that the air could not blow in towards a common centre without causing the barometer to rise above the mean. Mr. Forth says in the second volume of the Philosophical Transactions, (abridged,) that during a great depression of the barometer, January 8, 1735, he observed that the wind in the northern parts of the island blew from the N. E., and on the southern parts of the island from the S. W. And Mr. Howard says, in a great storm of 1812, the wind on the north of the Humber blew from the E. N. E., and on the south of the Humber from the S. W. Mr. Espy then stated that he found by calculating according to well-known chemical laws, that the caloric of elasticity given out in the air in which a cloud is formed, would expand the air in the cloud about 8000 cubic feet for every cubic foot of water formed in a cloud by condensation of the vapor ; and he exhibited an instrument which he called a nepheloscope, which enabled him to measure the expansion with great accuracy, and he found it to agree with the calculations made on chemical principles. He then proceeded to give an outline of his theory, premising that the numbers he should introduce were not intended to be strictly accurate, and would be subject to many corrections, one in particular, in which no notice had been taken of the specific heat of air under different pressures.*

This paper gave rise to a very interesting conversation, but from the great length of the paper itself, we can only direct attention to the leading points of the discussion. Prof. Stevelly called the attention of the Section to the fact that he had at the Edinburgh meeting in 1834, used the principle of cold, produced by rarefaction, to explain what he called the secondary formation of clouds, and thus the propagation of storms; and even assigned this rarefaction as the cause of the summer hail. He objected to the main position, however, in Mr. Espy's theory, that the *fall of temperature* caused by the expansion of any body of air rendered light by being loaded with moisture as it rose in the atmosphere, was the same as the *constituent temperature of the strata of air* into which it rose, that is, of equal tension. He

* A synopsis of Mr. Espy's philosophy of storms was published in Vol. 39, (pp. 120—132,) and we therefore omit it in this place.—*Eds.*

deduced from the numbers given by Poisson, that it was much greater; that a cloud would be colder and not hotter than the surrounding air, and therefore the violent ascending vortex calculated upon by Mr. Espy would not exist. Prof. Forbes had three objections to Mr. Espy's theory: 1st. the small funnel at the centre of a tornado, through which Mr. Espy supposed the air to rise, would be insufficient to vent all the air which would rush during a tornado, with the frightful velocity we know it to attain, through the constantly enlarging rings surrounding that central funnel, to the extent of many hundred miles. 2. As the tornado had a progressive motion, as Mr. E. admitted, it would be more difficult than Mr. E. supposed to deduce from the way in which the trees in its path were thrown, the actual course of the atmospheric particles at any instant, as each would move with a motion compounded of two motions, both varying in relative direction and magnitude. 3. All the vapor in the air would be condensed into cloud much sooner than Mr. E. supposed, and he thought it certain that the small amount of heat given out by the vapor would not suffice to expand the air in the funnel to the extent required, if Mr. Espy's views were correct. As to the question whether Mr. Redfield's and Col. Reid's theory of a whirl, or Mr. Espy's radial theory, was most accordant with fact, Mr. Osler said, that from the investigation he had given this subject, he was convinced that the centripetal action described by Mr. E. took place in most hurricanes. The particulars which he, (Mr. O.) had collected, together with the indications obtained from the anemometers at Birmingham and Plymouth, satisfied him that the action of the great storm of January 6 and 7, 1839, was not rotatory at the surface of the earth, when it passed across England. He differed, however, both from Mr. Espy and Mr. Redfield in one essential point, for he believed it would be almost impossible to have a violent hurricane without, at the same time, having both rotatory and centripetal action. A storm might very probably be generated in the first instance in the manner accounted for by Mr. Espy, or by the action of contrary currents: in the first case the rush of air toward a spot of greater or less diameter would not be perfectly uniform, owing to the varying state of the surrounding atmosphere; this together with the upward tendency of the current would, in some cases, produce a violent eddy or rotatory motion, and a whirlwind of a diameter varying with the cause would ensue; the centripetal action would thus be immensely increased, the *whirlwind itself* demanding a vast supply of air, which would be constantly thrown off spirally upwards, and diffused over the upper atmosphere, thus causing the high state of the barometer which surrounds a storm. He further stated that he had brought his theory of the combined action of centripetal and rotatory motion before the meeting at Birmingham, and a short notice of it would be found in the reports of the Sections. If no rotatory action takes place, he believed that we merely experienced the rush of air which necessarily precedes a heavy fall of rain or thunder storm; but he believed that nothing violent enough to be called a hurricane could take place, unless a violent rotatory or whirling action be first produced, and that in many and perhaps most cases, the rotatory portion is not in contact with the earth. Mr. Arch. Smith said there was one point which must not be overlooked in any correct comparison of the rival theories. From the principle of the conservation of areas it was perfectly certain, that if a storm was caused in the manner supposed by Mr. Espy, there must be a rotation, greater or less, in the centre. Because, unless the motion of all the currents were accurately directed to one point, or at least their *moments* in a horizontal plane were equal to zero, which was infinitely improbable, a motion of rotation must be the result, as in the instance of the motion of water in a funnel cited by Mr. Espy. If the central space of comparative rest were large, the whirl might be imperceptible; but if small, as in the case of a water-spout, it must be considerable. Without embracing either theory, he thought it difficult to conceive, as he understood Mr. O. to do, the motion of rotation to be the primary, and the centripetal, (which indeed would be centrifugal,) force to be the secondary phenomenon. But it was comparatively easy to suppose the centripetal motion to be the primary phenomenon, and quite certain that if so, there must result a secondary phenomenon of rotation, of which indeed some indications appeared in Mr. Espy's maps. In making some remarks on the preceding paper, Sir D. Brewster observed, that it was impossible to form any decided opinion on the subject from the great want of well ascertained facts; and as Mr. Espy had founded his theory expressly on observations, often made by himself, it was impossible to do justice to his ingenious views until a greater number of facts had been collected.

The facts too stated by Mr. Espy were opposed to those observed by others. In the case of hurricanes or tornadoes the convergence of the aërial currents in the one theory and their rotatory motion in the other were not *observed*, but *inferred* from a number of facts; but as Mr. Espy regarded water-spouts as formed in the same manner as tornadoes, and as Col. Reid had distinctly stated, (in his letter quoted before,) that he had *actually seen*, from the government house at Bermuda, by means of a telescope, the *water-spout revolving like the hands on a dial-plate of a watch*, there could be no doubt that we were at variance about facts. This explicit and distinct *observation* of a rotatory motion, by so able and accurate an observer as Col. Reid, was worth a thousand inferences. Prof. Phillips said that he thought the statements of facts connected with tornadoes as stated in the American Journals, were more consistent with Mr. Espy's than with Mr. Redfield's theory; and Col. Reid's thinking he saw rotation in a water-spout could not invalidate the abiding evidence from uprooted forests. Mr. Espy in his reply seemed to think he had been misunderstood, and answered Prof. Forbes's objections at considerable length.

A letter dated New York, July 28, 1840, from Mr. Wm. C. Redfield to Sir J. Herschel, was communicated to the meeting. With this letter Mr. R. had sent, by the steamship *British Queen*, a map showing the direction of the wind in the great storm of December 15, 1839, at noon, with a schedule of the observations: also, a sketch of the various directions of prostrated trees, &c. found in a section of the track of the New Jersey tornado of June 19, 1835, with a statement of the observations,—furnishing some of the evidences of *rotation* found in the tract of the tornado. Unfortunately neither of these communications had reached Sir J. Herschel, and there was reason to apprehend they were lost.

Mr. C. J. Kennedy read an elaborate paper on the theory of electricity.—A communication was read by Dr. Forbes, on the mean apsidal angle of the moon's orbit.—Mr. Fox read his report on subterranean temperature. Early in 1815, Mr. Joel Lean stated to him his conviction that the high temperature observed in our mines existed in the earth itself, increasing with the depth; and shortly afterwards his brother Thos. Lean, at their request, made many experiments in Huel Abraham copper mine, of which he was the manager, in order to test the correctness of this view. The result obtained by him tended to confirm it very unequivocally; and so did another series, made the same year in Dolcoath mine, by John Rule, Jr. one of the superintendents. Many other individuals have since at the request of Mr. F., carried on similar observations in different mines, all showing that the subterranean temperature increases in some proportion to the depth of the stratum. The tables of observations given in the Report confirm Mr. Fox's previous views, that the rate of increase is not so considerable at deeper excavations as at those which are shallower.—Mr. Eaton Hodgkinson read a paper on the temperature of the earth in the deep mines near Manchester.—Prof. Forbes made his report on the temperature and conducting powers of different strata. The results agree substantially with those reported by him last year.

Sir D. Brewster read a report on the *Phenomena and cause of muscæ volitantes.* As this paper was illustrated with several drawings, and contained minute experimental details, it is not easy to give a popular account of it. The following are the principal results. 1. In persons of all ages, and with the most perfect eyes, transparent filaments or tubes exist in the vitreous humor, and at different distances from the retina. 2. These filaments float in the vitreous humor, moving about with the motion of the head. 3. These filaments are seen by means of their shadows on the retina, and are most distinctly visible in divergent light, their shadows being bounded by fringes produced by diffraction or inflexion. 4. The real muscæ, resembling flies, are knots tied, as it were, on these filaments, and arising from sudden jerks or motions of the head, which cause the long floating filaments to overlap and run into knots. 5. By making experiments with the head in all positions, and determining the limits of the motions of the muscæ, by measuring their apparent magnitude, and producing double images of them by means of two centres of divergent light, the author was able to determine their exact place in the vitreous humor, and to ascertain the important fact that the vitreous humor in the living human eye is contained in cells of limited magnitude, which prevent any bodies which they contain from passing into any of the adjacent cells. The author concluded with the following observations: "I have dwelt thus long on the subject of *muscæ volitantes*, not only because it is an entirely new one, but also on account of its practical utility. Mr.

Mackenzie informs us that few symptoms prove so alarming to persons of a nervous habit or constitution as *muscæ volitantes*, and that they immediately suppose that they are about to lose their sight by cataract or amaurosis. The details which I have submitted to you prove that the *muscæ volitantes* have no connexion with either of those diseases, and are altogether harmless. This valuable result has been deduced from a recondite property of divergent light, which has only been developed in our own day, and which seems to have no bearing whatever of an utilitarian character; and this is but one of numerous proofs which the progress of knowledge is daily accumulating, that the most abstract and apparently transcendental truths in physical science, will sooner or later, add their tribute to supply human wants, and alleviate human sufferings. Nor has science performed one of the least important of her functions, when she enables us either in our own case or in that of others, to dispel those anxieties and fears which are the necessary offspring of ignorance and error."

Sir D. Brewster read a notice 'on the line of visible direction along the axis of vision.' In D'Alembert's memoir 'on different questions in Optics,' published in his *Opuscules Mathematiques*, tome i, he has maintained the singular opinion that distant objects, like the fixed stars, when viewed directly with both eyes, are not seen in their true direction, that is, neither in the direction of the rays which they send to the eye, nor of the line (coincident with it) drawn from the point of incidence on the retina through the centre of visible direction. The author pointed out the fallacy in D'Alembert's reasoning, and thus established in opposition to the opinion of that distinguished philosopher, the law of visible direction which he had explained at the Newcastle meeting.

Dr. Reade exhibited an experiment with an instrument which he called an *Iriscope*. A piece of black polished glass was rubbed over in part with a solution of Castile soap; as soon as it was dry, the soap was polished off with a glove, until, as far as appearances were concerned, the one part of the glass was as clean as the other. He then blew his breath on the plate through a tube about half an inch in bore, and instantly the most vivid rings of colors (resembling Nobili's) were exhibited where the breath condensed on the part of the glass which had been previously soaped: while, on the other part, the condensed breath exhibited simply the usual dead gray color.

Report of the Committee (Sir J. Herschel, Mr. Whewell, Mr. Peacock and Prof. Lloyd,) appointed to draw up plans of *scientific coöperation relating to the subject of terrestrial magnetism.* In consequence of the measures adopted as detailed in the last report of this committee, a very extensive system of corresponding magnetical observations has been organized, embracing between thirty and forty stations in various and remote parts of the globe, provided with magnetometers and every requisite instrument, and with observers carefully selected, and competent to carry out, at most, if not all the stations, a complete series of two-hourly observations, day and night, during the whole period of their remaining in activity, together with monthly term observations, at intervals of two minutes and a half. Of these observatories, that at Dublin, placed under the immediate superintendence of Prof. Lloyd, has been equipped and provided for by the praiseworthy liberality and public spirit of the University of that metropolis,—those at Toronto, the Cape of Good Hope, St. Helena, and Van Diemen's Land, as also the two itinerant observatories of the Antarctic Expedition by the British Government,—those of Madras, Simla, Sincapore and Aden, by the Hon. East India Company; to which are to be added ten stations in European and Asiatic Russia, and one at Pekin established by Russia,—two by Austria, at Prague and Milan,—two in the U. States; viz. at Philadelphia, by the Girard College, and at Cambridge by the American Academy,—one by the French government at Algiers,—one by the Prussian, at Breslau,—one by the Bavarian, at Munich,—one by the Spanish, at Cadiz,—one by the Belgian, at Brussels,—one by the Pasha of Egypt, at Cairo, and one by the Rajah of Travancore, at Trevandrum, in India. In addition to this list, it has recently also been determined, at the instance of the Royal Society, by the British Government, to provide for the performance of a series of corresponding observations, both magnetic and meteorological, at the Royal Observatory at Greenwich, under the able superintendence of the Astronomer Royal. At Hammerfest also, in Norway, negotiations have been for some time carrying on for establishing an observatory of a similar description, in which Mr. Hansteen has taken an especial interest. A great number of magnetic and other instruments available for this service, it appears have been left at Kaafiord, by M. Gaymard, acting for the "Commission Scientifique du Nord," under the direction of the French

Ministry of the Marine, all which instruments, through the efficient intervention of M. Arago, it is understood will be placed at the disposal of the observer or observers who may be appointed to conduct the observations. To complete the establishment, however, certain instruments, as well as registry-books, &c. are still requisite. The Council of the Royal Society have undertaken to supply these from the Wollaston Donation Fund.* As regards the magnetic observatory at Breslau, under the direction of M. Boguslawski, your committee have to report, that in order to secure the establishment of that station, and to place it on an equal footing with the rest, certain instruments, &c. required to be provided, for which no funds existed or could be made available on the spot, viz. a bifilar and a vertical-force magnetometer, with the requisite reading telescopes, and a set of registry-books. * * These were supplied at the expense of the Association. * * A letter from M. Boguslawski, dated July 22, 1840, announces the safe arrival of the instruments and books in question, and the consequent complete state of instrumental equipment of the Breslau observatory, expressing at the same time, his sincere thanks for the assistance accorded him. By returns from the several stations authorized by the British government, so far as yet received, it appears, that the observatories at the Cape and St. Helena might be expected to be complete and ready for the reception of the instruments in May. From Van Diemen's Land no accounts have yet been received. At Toronto, Canada, where the greatest delays and difficulties were to be expected and have been experienced, the observatory was so far advanced at the date of Mr. Riddell's last communication, as to leave no doubt of its completion in time for the regular observation of the August term.† Meanwhile, in this, as at the other stations, all observations practicable under the actual circumstances of each are made and regularly forwarded; and here your committee would espe-

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* An interesting view of the existing state of knowledge respecting terrestrial magnetism, and a detailed account of the present magnificent system of magnetic observations, is contained in a paper in the (London) Quarterly Review, July, 1840, No. 131, Vol. 66.—Eds.

† On the *term days,* which begin on the Friday preceding the last Saturday in February, May, August and November, at 10*h*. P. M. *Göttingen mean time,* the magnetic observations are continued for twenty-four successive hours, at intervals of *two and a half minutes.* Similar observations are also made on the Wednesday preceding the 21st of each remaining month.—Eds.

cially call attention to the extremely remarkable phenomena exhibited at Toronto on the 29th and 30th of May, when, by great good fortune, a most superb Aurora appeared at the very time of the term observations. The phenomena of this Aurora, which was remarkable for the extent and frequency of the pulsating waves, (alluded to in the Report of the Council of the Royal Society, relating to this subject,) are very minutely and scientifically described by Mr. Riddell.* But what renders the occurrence presently interesting, is the fact, that during the whole time of the visible appearance of this aurora on the night from the 29th to the 30th, as well as for some hours previous, while it might be presumed to be in progress, though effaced by daylight, all the three magnetical instruments were thrown into a state of continual and very extraordinary disturbance. In fact, at 6*h.* 25*m.* in the morning of the 29th, the disturbance in the magnetic declination during a single minute of time carried the needle over ten minutes of arc; and during the most brilliant part of the evening's display (from 3*h.* 25*m.* Gött. m. t. to 4*h.* 35*m.*) the disturbances were such as to throw the scales of both the vertical and horizontal force magnetometers out of the field of view, and to produce a total change of declination, amounting to 1° 59′. It should also be remarked, that the greatest and most sudden disturbances were coincident with great bursts of the auroral streamers. The correspondence or want of correspondence of these deviations with the perturbations of the magnetic elements observed in Europe and elsewhere on the same day, cannot fail to prove of great interest. Should it fortunately have happened that Capt. Ross has been able to observe that term at Kerguelen's Land, which is not very far from the antipodes of Toronto, an indication will be afforded whether or not the electric streams producing the aurora are to be regarded as diverging from one magnetic pole or region, and converging to another. Your committee cannot conclude this report, without congratulating the Association and the scientific world in general on the extensive interest inspired, and the vast range of observation consequently embraced by this operation, which, so far as any accounts have

* Some notices of this auroral display have appeared in this Journal, (Vol 39, pp. 194, 383.) It was attended with a singular auroral belt, extending over head from east to west, which was seen as far eastward at least as Nantucket, and westward several hundred miles from that island.—Eds.

hitherto reached them, appear to be going on prosperously in all its parts, and to promise results fully answerable to every expectation of its promoters. Neither would they feel justified in their own eyes, were they to omit expressing their deep and grateful sense of the indefatigable personal exertions of Major Sabine throughout the whole of the progress, both in carrying on a most voluminous correspondence, in ordering, arranging and dispatching instruments, and facilitating, by constant attention and activity, those innumerable details which are involved in a combination so extensive,—a combination, which, but for those exertions, your committee are fully of opinion must have been greatly wanting in that unity of design and coöperation which now so eminently characterizes it.—Signed, on the part of the committee, J. F. W. Herschel.

The following is a list of the magnetic observatories established by the Russian government, viz. St. Petersburgh, Catharinenburgh, Barnaoul, Nertchinsk, Kazan, Nikolaieff, Tiflis, Sitka, (N. W. coast of America,) Helsingfors in Finland, and Pekin in China.

The *Astronomer Royal* announced that her Majesty's government had sanctioned the establishment of a magnetic observatory at the Royal Observatory at Greenwich. In reference to the aurora seen at Toronto, in Upper Canada, on the 29th of May, and to the magnetic perturbations by which its perturbations had been accompanied, he stated that the term day of the 29th, and 30th of May, 1840, had also been kept at the Royal Observatory at Greenwich; that an aurora was seen there also on the 29th, and that the disturbances of the declination magnetometer exceeded in any amount which had been observed there on previous occasions. Observations had for some time past, been made under his superintendence, and he had observed some remarkable auroral disturbances of the needle, when the amount of the deflection had, as well as he remembered, exceeded half a degree. The coincidence of these disturbances had not been exact; at Greenwich as in America, they had been found to occur earlier than in those places more to the east.

Dr. Lamont gave an account of the magnetic observatory at Munich, regular observations at which, were begun Aug. 1, 1840. It differs in two respects from other establishments of this kind. It is 13 feet below the earth's surface, thus affording the advantage of a temperature nearly equal throughout the year. Secondly, the instruments are of unusually large dimensions, and are in all respects sufficient for the most delicate investigations.—Dr. L. gave also a general statement of the system of meteorological observations carried on in Bavaria; the results of which appear in the annual publications of the Royal Observatory of Munich.

Prof. Jacobi, of St. Petersburgh, gave a historical sketch of the laws which regulate the action of *Electro-magnetic machines.* After recounting the theoretical researches carried on by himself with the assistance of M. Lenz, he adds, " Unfortunately, I cannot here give the details either of the experiments which I have made upon a very large scale, or of the machines and apparatus of various kinds which I have constructed. The necessity of multiplying the facts or tangible results,—a necessity the more urgent, because the practical applications of this force increased so very rapidly,—this necessity I say, has not allowed me time to digest and arrange them. I will, however, particularly notice the satisfactory results of the experiments made last year with a boat of 28 feet long, and 7½ feet wide, drawing 2¾ feet of water, and carrying 14 persons, which was propelled upon the Neva at the rate of about 3 English miles in the hour. The machine, which occupied very little space, was set in motion by a battery of 64 pairs of platinum plates, each having 36 square inches of surface, and charged according to the plan of Mr. Grove, with nitric and diluted sulphuric acid. Although these results may perhaps not satisfy the exaggerated expectations of some persons, it is to be remembered that in the first year, viz. in 1838, this boat being put in motion by the same machine, and employing 320 pairs of plates, each of 36 square inches, and charged with sulphate of copper, only half this velocity was obtained. This enormous battery occupied considerable space, and the manipulation and management of it were very troublesome. The judicious changes made in the distribution of the rods, in the construction of the commutator, and lastly in the principles of the voltaic battery, have led to the successful result of the following year, 1839. We have gone thus on the Neva, more than once, and during the whole day, partly with and partly against the stream, with a party of 12 or 14 persons, and with a velocity not much less than that of the first-invented steamboat. I believe that more cannot be expected from a mechanical force, whose existence has only been known since 1834, when I made the first experiment at Königsberg, in Prussia, and only succeeded in lifting a weight of about 20 ounces, by even this electro-magnetic power.

"I must on the present occasion, confess frankly that hitherto the construction of electro-magnetic machines has been regulated in a great measure by mere trials; that even these machines constructed according to the indisputable laws established with regard to the statical effects of electro-magnets, have been found inefficient, as soon as we came to deal with motion. Being always accustomed to proceed in a legitimate manner, and feeling great regret at the irregular attempts which were being made every where, without any scientific foundation, this state of things appeared to me so unsatisfactory, that I could not but direct all my efforts to ascertain clearly the laws of these remarkable machines. I submit the formulæ relative to these laws, which appear to me to recommend themselves as much by their simplicity as by the natural manner in which they develope themselves. Let R represent all the mechanical resistances acting upon the machine, and v the uniform velocity with which it moves; we have for the power or mechanical effect, the expression $T = Rv$. Let n be the number of coils of the helix which covers the rods; z the number of the plates of the battery; B the total resistance of the galvanic circuit; E the electro-motive force; k a coefficient which depends on the arrangement of the bars, the distance of the poles, and the quality of the iron; we have then for the maximum of the mechanical effect which will be obtained, the expression,

$$\text{I.} \quad T_m = \frac{z^2 E^2}{4Bk}.$$

For the velocity, which corresponds to this maximum,

$$\text{II.} \quad v = \frac{B}{kn^2}.$$

For the resistance acting upon the machine,

$$\text{III.} \quad R = \frac{n^2 z^2 E^2}{4B^2}.$$

Lastly for the economic effect, i. e. the duty or the mechanical effect divided by the consumption of zinc in a given time,

$$\text{IV.} \quad O = \frac{E}{2k}.$$

These formulæ may be expressed in the terms,

1. The maximum of mechanical effect which may be obtained from a machine, is proportional to the square of the number of voltaic elements, multiplied into the square of the electro-motive force, and divided by the total resistance of the voltaic circuit. There enters, moreover, into the formula, a factor which I have designated k, and which depends upon the quality of the iron, the form and disposition of the rods, and the distance between their extremities. The result is, that with reference to some other investigations, which I have made of voltaic combinations, and under similar conditions, the use of platinum, zinc, the resistance being the same, will produce an effect two or three times greater than the use of coeppr, zinc.

2. Neither the number of the coils of the helix which covers the rods, nor the diameter, or the length of the rods themselves, has any influence upon the maximum of the power. It results, therefore, that neither by adding to the length or diameter of the rods, nor by employing a greater quantity of wire, can the power be increased. There is however, this remarkable fact, that the number of coils disappears from the formula, simply because the force of the machine is in a direct ratio, and the velocity is in an inverse ratio, to the square of this number. It is thus that the number of coils, the dimensions of the rods, and the other constituent parts of an electro-magnetic machine, should be considered simply as occupying the range of the ordinary mechanisms which serve for the transmission or transformation of the velocity, without increasing the available power. So it would be possible to use, instead of the ordinary wheelwork, rods of greater or less length, or a greater or less quantity of wire, in order to establish between the force and the velocity the relation which the applications to manufacturing processes may require.

3. The mean attraction of the magnetic rods, or the pressure which the machine can exert, is proportional to the square of the current. This pressure is indicated by the galvanometer, which in this manner performs the function of the manometer of steam engines.

4. The economic effect, i. e. the duty or the available power, divided by the consumption of zinc, is a constant quantity, which is expressed most simply by the relation between the electro-motive force and the factor k, which has been previously noticed.

I may here repeat what I stated elsewhere, that by employing platinum instead of copper, the theoretical expenses may be reduced in the proportion of nearly 23 to 14.

5. The consumption of zinc, which takes place while the machine is at rest, and does no work at all, is double that which occurs while it is producing the maximum of power.

I consider that there will not be much difficulty in determining with sufficient precision, the duty of one pound of zinc, by its transformation into the sulphate, in the same manner that in the steam engine, the duty of one bushel of coal serves as a measure to estimate the effect of different combinations. The future use and application of electro-magnetic machines appear to me quite certain, especially as the mere trials and vague ideas which have hitherto prevailed in the construction of these machines, have now at length yielded to the precise and definite laws which are conformable to the general laws which nature is accustomed to observe with strictness, whenever the question of effects and their causes arises. In viewing on the one hand a chemical effect, and on the other a mechanical effect, the intermediate term scarcely presents itself at first. In the present case, it is magneto-electricity, the admirable discovery of Faraday, which we should consider as the regulating power, or as it may be styled, the logic of electro-magnetic machines.

Prof. Kelland read a paper having for its object to point out the state of our experimental knowledge of the transmission of heat, and to exhibit its total inadequacy to serve as the test of any precise and accurate theory.

Dr. Anderson made a communication concerning the *meteorology of Perth.* This place is about 30 feet above the mean level of the ocean, in lat. 56° 23′ 40″ N.; lon. 3° 26′ 20″ W. The magnetic variation there, (which seemed to have reached its maximum in 1815,) was 26° 54′ W. in Nov. 1836: the magnetic dip was 72° 10′ in May, 1838. The mean barometrical pressure deduced from a period of consecutive observations, continued from 1829 to 1835, was 29.802 in., the time of observation being nine o'clock in the morning. The extreme range of the barometer during this period was 2.821 inches. The mean temperature is about 48° F. The mean annual quantity of rain from 1829 to 1834 was 30.89 inches.

Sir D. Brewster read a paper on the cause of the *increase of color in objects seen with the head inverted.* It has been long known to all artists and tourists, that the colors of external objects, and particularly of natural scenery, are greatly augmented by viewing them with the head bent down and looking backwards between the feet, that is, by the inversion of the head. The colors of the western sky, and the blue and purple tints of distant mountain scenery are thus beautifully developed. This position of the head is a very inconvenient one; but the effect may be produced nearly to the same extent by inverting the head so far as to look at the landscape backwards beneath the thighs or left arm. It is not easy to describe this change of color, but it may be stated that the colors of distant mountains, which appear tame and of a French gray color when viewed with the head erect, appear of a brilliant blue or purple tint with the head inverted. * * While in perplexity about the cause of the phenomenon in question, I had an opportunity of observing the great increase of light which took place in an eye in a state of inflammation. This increase was such, that objects seen by the sound eye appeared as if illuminated by twilight, while those seen by the inflamed eye, seemed as if they were illuminated by the direct rays of the sun. All colored objects had the intensity of their colors proportionally augmented; and I was thus led to believe that the increase of color produced by the partial or total inversion of the head, arose from the increased quantity of blood thrown into the vessels or the eye-ball,—the increased pressure thus produced upon the retina, and from the increased sensibility thus given to the sentient membrane. Subsequent observations have confirmed this opinion, and though I cannot pretend to have demonstrated it, I have no hesitation in expressing it as my conviction that the apparent increase of tint to which I have referred, is not an optical, but a physiological phenomenon. If this is the case, we are furnished with a principle which may enable us not only to appreciate faint tints, which cannot otherwise be recognized, but to perceive small objects which, with our best telescopes, might be otherwise invisible.

Mr. Snow Harris's report on the working of Whewell's anemometer at Plymouth, was read by the secretary. The instrument being now effectively at work, Mr. H. proposes to have completed by the next meeting a graphical delineation of the integral amount of wind shown by it at Plymouth for the entire year, and in the mean time he sent drawings and tables which contain the results of its work for the last three months.

Sir David Brewster then offered some remarks on microscopes, and his mode of illuminating microscopic objects.

Prof. Nichol gave an account of the astronomical observatory erecting near Glasgow. Two reflectors by Ramage had been obtained, one of 25 feet focal length, to which Sir J. Herschel's collimator is to be affixed, and another of 55 feet focal length and 23 inches in diameter. A transit-circle had been been ordered from Munich, the telescope of which is 8 feet focal length and 6.25 inches diameter. An equatorial of great power was also in expectation.

Mr. Airy, the astronomer royal, gave an explanation of a new apparent polarity of light, announced some time since by Sir D. Brewster. His explanation resulted in showing that the phenomenon is a simple consequence of the undulatory theory. Sir D. Brewster remarked that Prof. Powell's solution of this problem was fallacious, and that of Mr. Airy did not explain all the facts. A full account of experiments on the phenomenon in question is now preparing for the Royal Society.

Sir D. Brewster gave an account of a rainbow seen in Dumfriesshire by Rev. Mr. Fisher, in which the primary bow was accompanied with *five* supplementary bows, and the secondary one with *three;* a larger number than had been before noticed.

Mr. Airy explained the principles of Mr. Fowler's new calculating machine, the object of which was to facilitate the guardians of a poor-law district in Devonshire, in calculating the proportions in which the several divisions were to be assessed.

Dr. Anderson then submitted some observations on the dew point, in which he explained the principles of the formula which he deduced several years ago, from the experiments of Dalton and Gay-Lussac, for determining the various objects connected with the hygrometric state of the air; and showed by means of tables which he had constructed from it, the facility and dispatch with which the absolute as well as the relative humidity of the atmosphere, together with the dew point, might be obtained.

Mr. Shand read a paper on the agency of sound, adverting to the rules and principles by which it is governed, and with particular reference to the economy of voice in public apartments.

Mr. Graham Hutchinson read a paper on a method of prognosticating the probable mean temperature of the several winter months, from that of corresponding months in the preceding summer.

Mr. Wm. Bald continued a series of observations made in 1839, and 1840, on the tides in the harbor of Glasgow, and the velocity of the Tidal Wave in the estuary of the river Clyde, between Glasgow and Port Glasgow.

[*The remainder is unavoidably deferred to the next number.*]

Art. IX.—*Abstract of a Meteorological Journal for the year* 1840, *kept at Marietta, Ohio, Lat.* 39° 25′ *N., and Lon.* 4° 28′ *W. of Washington City;* by S. P. Hildreth, M. D.

Months.	Thermometer.				Fair days.	Cloudy days.	Rain and melted snow.		Prevailing winds.		Barometer.		
	Mean temperature.	Maximum.	Minimum.	Range.			Inches.	100ths.			Maximum.	Minimum.	Range.
January,	25.00	43	–4	47	11	20	2	33	W., N. W.		29.80	28.78	1.02
February,	41.00	74	–0	74	15	14	3	08	W., S. W., S. E.		29.75	28.88	.87
March,	48.66	78	16	62	12	19	3	21	W., N., S. E.		29.64	28.82	.82
April,	56.57	88	26	62	17	13	4	25	S. W., N., S. E.		29.74	29.10	.64
May,	61.80	91	33	58	21	10	5	21	S., S. E.		29.55	28.92	.63
June,	68.66	89	43	46	19	11	4	25	S., S. W.		29.68	29.10	.58
July,	71.25	92	51	41	23	8	2	17	S., S. W.		29.63	29.25	.38
August,	72.43	90	51	39	22	9	5	25	S., S. W.		29.65	29.20	.45
September,	57.27	82	34	48	20	10	2	00	S., S. E., N.		29.75	29.12	.63
October,	52.83	82	19	63	19	12	3	92	S. W., W., N. W.		29.60	29.08	.52
November,	40.60	68	22	46	14	16	1	92	W., S. W.		29.70	28.88	.82
December,	32.14	58	6	52	11	20	1	50	W., N. W.		29.75	28.85	.90
Mean,	52.55				204	162	39	09					

Remarks on the year 1840.—The mean temperature for the year is 52.35°, which varies but a small portion of a degree from that of the preceding year. The amount of rain and melted snow is 39.09 inches, which is a few inches below the annual mean for this place, but is about six inches greater than that of the preceding year. The distribution has been regulated in a remarkable manner, so as to be most abundant in those months, where the heat and evaporation are the greatest, and moisture most needed for the growth of plants and filling out the ripening grain. The mean temperature for the several seasons is as follows.—N. B. The winter embraces December of 1839.

Winter months, 34.11°. Spring months, 55.70°. Summer months, 70.85°. Autumn months, 50.24°. There is a great similarity in the seasons of the two past years, the difference being not more than a degree in any one of them. The range of the barometer has been less than in the preceding year, the mercury rising at no time higher than 29.80, or sinking below 28.78. January was a very cold month, the mean being 25°, which is ten degrees below that of 1839. Although the mercury did not fall at any time to more than 4° below zero, yet it was below and near to that point on ten mornings. February, which is usually the coldest month, was this year six degrees warmer than January. March was six degrees warmer than that of last year, and brought forward the blooming of plants somewhat earlier. The past year in the west, has been somewhat remarkable for storms of wind and hail. On the 23d of April, at half past four P. M., a tornado swept across the S. E. portion of the town of Marietta, near the Ohio river, unroofing several buildings, and blowing down the brick gable ends; quite a number of ornamental trees were prostrated. It crossed the Ohio from Virginia, where it did considerable damage to fences, trees, &c. The force of the wind continued only for a few minutes, and was not very extensive. On the third day of May, a similar tornado visited Gallipolis and vicinity, doing considerable damage to buildings, trees and fences. It took place at half past four P. M. The same gust reached Marietta at half past five, but was not so violent.

Gallipolis lies about sixty miles distant in a S. W. direction from Marietta. On the 18th of June, about noon, an uncommon shower of hail fell upon a district of country three miles south of this place. It commenced in the state of Ohio, a few miles west of the river, ranging nearly east and west, and crossed the river into Virginia, passing over the large island below town. It was about a mile in width, and eight or ten miles in length. A constant discharge of electric fluid attended the shower, not however, in very loud peals of thunder, but with a continual roar, like the rumbling of carriages over hard ground. So immense was the quantity of hail, that it covered the earth to the depth of six or eight inches, destroying the wheat, rye and oats, entirely, beating them into the ground. Indian corn was greatly damaged, but made a tolerable crop, where the plants were trimmed carefully with a knife and set upright. Apples and peaches, half grown, were torn with the leaves, from the trees, presenting a very dismal appearance. A man who was plowing corn on the island, took shelter under an apple tree, thinking it only a common shower. He was bare-footed and bare-legged, and in his shirt sleeves. The hail covered his feet above the ankles, and nearly froze them before he could reach the shelter of a deserted building that stood near the field. Sheep, fowls, and small animals suffered severely from the effects of the hail. At Marietta, the cloud discharged rain principally, with a few scattering hail-stones. The wind was light at the time, or the damage must have been much greater. Large quantities of the unmelted hail remained until the next day. It had quite an effect on the temperature at Marietta, as the mercury, which stood at 68° in the morning, sunk to 62° at 2 o'clock P. M., while the day before, it was at 80°, and the day following, at 76° at the same hour.

Flowering of plants and trees, ripening of fruit &c., in 1840.—March 1, Mezereon in bloom ; 2, white maple, and red elm ; 18, early hyacinths ; 20, daffodil and dew-drop ; April 2, Pyrus japonicus ; 3, peach and white-heart cherry begin to open ; 4, damson ; 5, imperial gage ; 7, peach in full bloom ; 8, winter, or pound-pear—puccoon and anemone ; 10, service tree ; 11, Judas tree, or red-bud ; 13, apple nearly open ; 16, apple in full bloom, early tulips open ; 19, Cornus florida, or dog-wood ; 21, tree peony, papaveracea, quince tree ; 22, tulips in full bloom, apple shedding its blossoms ; 25, lily of the valley, yellow mocason flower, or Cypripedium parviflorum ; 27, Anona glabra ; May 2, yellow single rose ; 5, Isabella and Catawba grape ; 6, a smart frost, which destroyed many of the grape blossoms ; 14, black walnut, Rubus villosa, or black-berry ; 17, white rose, and white Chinese peony, for which latter flower the rose-bugs have an especial liking ; 22, many varieties of hardy roses in bloom ; 25, Gladiolus, and Pæonia fragrans ; 26, peas fit for the table, some years they are six or eight days earlier ; 27, pine-apple strawberry ripe ; June 6, white lily in bloom ; 13, early Russian cucumber fit for the table, grown without artificial heat ; 14, red Antwerp raspberry ripe ; 17, Lilium Pennsylvanicum in bloom ; 19, blight in pear and quince trees, worse than ever before known, nearly destroying trees of fifteen years growth ; 20, rye harvest begun; 27, chandler apple ripe; July 2, wheat harvest begun; 14, Vaccinium frondosum, or whortleberry, ripe, grows on the hills, amongst the yellow pine; 15, Rubus villosus, or blackberry ripe.

Columba migratoria.—The forest trees generally, this year abounded with fruit, being what is called in the west, "a fine year for mast." In such seasons, we are generally visited with immense flocks of the Columba migratoria, or wood pigeon. This year they appeared about the 15th of September, filling the woods with their numbers. One of their "roosts" was selected about a mile and a half from Marietta, in the uplands, where the timber was a second growth; the trees generally small, and many of them mere saplings. From near sunset to an hour after, the air was filled with their winged squadrons, and the trees and bushes loaded with pigeons, seeking a resting place for the night. They found it however, a very unquiet one, for the young men and boys visited them every night with torches of pine wood, killing them with shot guns, and knocking many down with sticks, until they were tired with the sport. After about two weeks, the pigeons shifted their nocturnal camping ground, either from the disturbance of the hunters, or to a more plentiful region for food. The "roost" covered a space of several hundred acres, so that their numbers must have amounted to many millions. Between daylight and sunrise, they uniformly visited the shore of the Ohio river, for drink, or for small gravel stones to assist in digesting. At this period, the vigilant sportsman had fine amusement in shooting them on the wing, as they rose over the top of the bank where he was standing, killing sometimes two or three dozen at a single discharge. Although this beautiful bird has been subject to the depredation of man for more than fifty years in Ohio, in addition to the multitudes that annually fall a prey to their feathered enemies, they still exist in vast numbers. What then must have been the amount of their winged hosts, as they yearly migrated from the warm regions of the south, to the cooler districts of the north, as instinct and habit directed, before civilization had made any inroads on the vast forests which had for ages supplied them with food.

Marietta, January 5th, 1841.

Art. X.—*Contributions towards a History of the Star-Showers of Former Times;* communicated by Edward C. Herrick, Rec. Sec. of the Conn. Acad.

[Read before the Connecticut Academy of Arts and Sciences, April 28, 1840; and since revised.]

A full account of the showers of shooting stars which have visited our planet, would much enlarge our knowledge of the system of bodies from which we receive these brilliant strangers. But a mere catalogue even, of all these displays is too much to hope for, inasmuch as some of them have doubtless been concealed by clouds, and others witnessed only by barbarians. Of those which have been preserved by the historian, a complete collection cannot at present be made in this country, owing to the insufficiency of our means of historical inquiry. A large portion of the materials for the present paper was collected in a search which I made in 1837 and 1838, for the purpose of obtaining evidence of the annual occurrence in August of an unusual number of shooting stars. The publication of the paper has been delayed in the hope that it might be rendered less incomplete; but I have now concluded to offer it in its present state, trusting that those who have the opportunity, will supply its deficiencies and correct its errors.*

(1.) 1768 *years before Christ.* "In the fiftieth year of the reign of the emperor Kié or Li-Koué, i. e. the year 1768 [before Christ] the Chinese saw stars falling:" [des étoiles tomber.]—*Cométographie par M. Pingré*, Paris, 1783, t. 1, p. 248, 4to.; quoted from the *Monarchiæ Sinicæ Synopsis Chronologica*, annexed to Vol. 2, of *Voyages* de Mel. Thévenot, Paris, 1696.

This statement is quite indefinite, and I cite it with some hesitation. The most probable meaning seems to be that a large number of shooting stars was seen; but it remains to be determined whether the original record warrants the construction here assumed.

(2.) 686 B. C. In the reign of the Emperor Le-wang, B. C. 686, "the stars disappeared, and meteors fell like rain."—*Medhurst's China*, London, 1838, 8vo. App. No. 1, p. 570.

* A partial list of the dates of these meteoric showers, was given in Vol. xxxiv, p. 182, and also in Vol. xxxv, p. 367.

This at first view appears to be a very clear case, but its resemblance to an instance mentioned in the Catalogue of Bolides, &c. observed in China, (Abel-Rémusat, Jour. de Phys. 1819,) which reads thus—"687 *ans avant J. C.* * * *les étoiles ne paroissoient pas,* * * *il tomba une étoile en forme de pluie,*"—induces the suspicion that the Chinese annalist may mean to state only the appearance of a single meteor which exploded into fragments. See note under No. (6.)

(3.) A. D. 7. "In the thirty sixth year of his reign, [i. e. of Synin who began to reign in the year of Synmu 632, before Christ 29 years,] it rain'd Stars from Heaven, in Japan."—*Hist. of Japan, by Engelb. Kæmpfer, M. D.*, trans. by J. G. Scheuchzer, London, 1728, folio, Vol. 1, p. 162.*

(4.) A. D. 532. "In the same year [A. D. 532] there happened a great chasing of stars from evening until morning, so that every one was amazed, and cried out—The stars are falling! We never knew any thing like it!"

"Τῷ δ' αὐτῷ ἔτει καὶ ἀστέρων γέγονε δρόμος πολὺς ἀπὸ ἑσπέρας ἕως αὔγους· ὥστε πάντας ἐκπλήττεσθαι, καὶ λέγειν, ὅτι οἱ ἀστέρες πίπτουσι, καὶ οὐκ οἴδαμεν ποτὲ τοιοῦτο πρᾶγμα."—*Theophanis Chronographia: Hist. Byzant. Script. Corp.* ed. Venet. fol. 1729, tom. 6, p. 126.

The following account of the same event is given by Cedrenus: "In the same year there was a great running of stars, so that all were astonished, and exclaimed—See! the stars are falling! We don't know what is to happen."—*Geo. Cedreni Comp. Hist.;* Hist. Byz. Sc. Corp. tom. 7, p. 292.—Stated also in Jo. Malalæ Chronog. l. 18, p. 477, cons. B. G. Niehbuhr, Bonnæ, 8vo. 1838.

This is the shower referred to A. D. 533, in Chladni's *Feuer-Meteore*, p. 88.†

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* In the same work are the two following accounts, which may perhaps relate to meteoric showers.

A. D. 11. "In the 40th year of his reign, [i. e. of Synin,] on a clear and serene day, there arose of a sudden in China, a violent storm of thunder and lightning: Comets, *Fiery-Dragons and uncommon Meteors appeared in the Air, and it rain'd fire from Heaven.*" p. 163.

A. D. 771. "In the second year of his reign, [i. e. of Koonin,] there happened a storm of thunder and lightning dreadful beyond expression. *It rained fire from Heaven, like stars*, and the air was filled with a frightful noise." p. 175.

† In E. H. Burritt's *Geography of the Heavens*, (5th ed. 1838, 12mo.) p. 161, it is said that "as early as the year 472, in the month of November, a phenomenon of this kind [a shower of shooting stars] took place near Constantinople. As Theophanes relates, 'the sky appeared to be on fire with the coruscations of the flying meteors.'" This is a mistake. It was a shower of volcanic dust from Vesuvius.

(5.) A. D. 558. "Some time after this, there was a great running of stars from evening until morning, so that every one was greatly terrified, and exclaimed,—'the stars are falling.'"

"Μετὰ δὲ χρόνον τινὰ, γέγονεν ἀστέρων δρόμος ἀφ' ἑσπέρας ἕως πρωῒ, ὥστε πάντας ὑπερεκπλήττεσθαι καὶ λέγειν, ὅτι πίπτουσιν οἱ ἀστέρες."—Geo. Cedreni Compend. Historiarum ; Hist. Byz. Sc. Corp. tom. 7, p. 304.

(6.) A. D. 585. "In the 8th moon, on the day Ou-chin [September 4 ?] there appeared many hundred shooting stars scattering themselves on all sides."

"A la 8e lune, le jour Ou-chin, il parut plusieurs centaines d' étoiles coulantes qui tombèrent en se dispersant de tous côtés."—*Catalogue des Bolides et des Aérolithes observés à la Chine, etc. tiré des livres Chinois, par M. Abel-Rémusat : Jour. de Phys.* 1819, t. 88, p. 356.*

(7.) A. D. 611. A shower of shooting stars is referred to by Sojuty, as having occurred this year. See No. (29.)

(8.) A. D. 744 or 747. "And the stars came forth shooting exceedingly."

"And steorran foran swythe scotienda."—*Chron. Saxonicum*, edit. Gibson, 4to. Oxon. 1692, p. 55.

(9.) A. D. 750. "At that time happened a fearful sight and a strange portent resulting from an appearance in the sky. It began about candle-lighting and was visible during the whole night, causing surprise and great fear in all the beholders. For

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* This Catalogue is derived chiefly from the compilation of a Chinese author, Ma-tou-an-lin, who has given a chronological account of fire-balls, meteorites, &c. down to A. D. 1221. Abel-Rémusat has generally omitted those cases where the meteor did not explode, so that it is quite probable that the original list comprises several star-showers. Some of the following instances cited by Rémusat, may perhaps prove to be such showers, but they cannot be so considered without further evidence. Some of them appear to be only single meteors which left trains of sparks.

687 B. C. En été, à la 4e lune, le jour Sin-mao (5e de la lune) les étoiles ne paroissoient pas, quoique la nuit fût claire, il tomba une étoile en forme de pluie.

15 B. C. A la 2e lune, le jour Koueï-weï, après minuit, il tomba une étoile en forme de pluie.

268 A. D. A la 7e lune, une étoile tomba en pluie du côté de l'ouest.

288 A. D. A la 8e lune, le jour Ji-tseu, nouvelle pluie d'étoiles.

532 A. D. A la 7e lune, le jour Kia-tchin, une étoile tomba en pluie.

837 A. D. A la 9e lune, le jour Ting-yeou il y eut une étoile de la grosseur d'un boisseau, etc. Plusieurs centaines de petites étoiles le suivoient.

1002 A. D. A la 9e lune, le jour Phing-chin, il y eut une étoile qui sortit de l'Orient, etc. Plusieurs dixaines de petites étoiles la suivoient et tombèrent avec elle.

it seemed to them as though all the stars left their appointed places in the heavens, and descended towards the earth. But when they came near the ground, they were one and all suddenly dissipated without doing any damage whatever. Many assert that this astonishing sight was witnessed throughout the whole world."

"*Συνηνέχθη γὰρ τηνικαῦτα θέαμα φοβερὸν καὶ τεράστιον ξένον ἐξ ἀερίου γενέσθαι συμπτώματος· ὅπερ περὶ λύχνων ἀφὰς κατάρξαν, διὰ πάσης ἐφαίνετο νυκτὸς, ἔκπληξιν καὶ δέος μέγα τοῖς θεωμένοις ἐμποιοῦν ἅπασιν. Ἐδόκει γὰρ αὐτοῖς ὡς οἱ ἀστέρες ἅπαντες τοῦ τεταγμένου αὐτοῖς οὐρανίου χώρου παρ * * * ιούμενοι κατὰ γῆς ἐφέροντο. Οἱ δὲ περίγειοι γενόμενοι ἀθρόον διελύοντο, ἥκιστα τὴν οἱανοῦν βλάβην ποιησάμενοι πώποτε. Φασὶ δὲ πολλοὶ ὡς διὰ πάσης τῆς οἰκουμένης τὸ τοιοῦτον ἐξαίσιον διεδεικνύετο θέαμα.*"—*Sancti Nicephori Patr. Constantinop. Breviarium Hist:* Hist. Byz. Scr. Corp. tom. 7, p. 33.

(10.) A. D. 764. "In the same year, in the month of March, stars were seen falling from heaven, so that all the beholders imagined that the end of the world had come. There was also a great drought, and the fountains were dried up."

"*Τῷ δ᾽ αὐτῷ ἔτει μηνὶ Μαρτίῳ ἀστέρες ἐκ τοῦ οὐρανοῦ πίπτοντες ὤφθησαν, ὡς πάντας τοὺς ὁρῶντας τὴν τοῦ παρόντος αἰῶνος ὑπολαμβάνειν εἶναι συντέλειαν· αὐχμός τε πολὺς γέγονεν, ὡς ξηρανθῆναι καὶ πηγάς.*"—*Stephanis Chronographia:* Hist. Byz. Scr. Corp. tom. 6, p. 291.—See also *Hist. Miscellæ*, lib. 22, Muratori: Rer. Ital. Scr. tom. 1, p. 159:—*Calvisii Opus Chronol.* fol. 1685, p. 634.

This is the shower referred to A. D. 763, in Chaldni's *Feuer-Meteore*, p. 88.

(11.) A. D. 765. "On Saturday, the fourth day of January, A. D. 765, stars were seen falling as it were from heaven."

"Anno 1076, [Græcorum; Christi 765,] mense Canun posteriori, (Januario,) die 4, feria 6, stellæ quasi e cœlo decidere visæ sunt."—*Dionysius Patriarcha, in Assemanni Biblioth. Orient.*, tom. 2, p. 112. Romæ, 1721, folio.*

(12.) A. D. 829. "An Earthquake at Aix a few Days before Easter, and a violent Hurricane. Another Comet in Aries. And for several Days together, very many little twinkling Fires like Stars, ran up and down in the Air; great Tempests of Wind followed. *Chr. Magdeb.—General Chronological History of the*

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* In the Saxon Chronicle, under date of A. D. 793, it is stated that *fiery dragons* [a common term for very brilliant meteoric fire-balls,] *were seen flying through the air*. It does not appear whether they were numerous.

Air, Weather, &c. [by Dr. Thos. Short.] 2 vols. 8vo. Lond. 1749. Vol. I, p. 86.

This account is not altogether intelligible, and I have not been able to find any other testimony concerning the occurrence.

(13.) A. D. 855. October 17. "This year there was a fall of stars during the night preceding the first day of the month Djomadi II, (Hegira 241,) which continued from the beginning of the night until dawn. At the same period earthquakes were felt in all parts of the world."

"Dans cette année (savoir 241) il arriva une chute d'étoiles dans la nuit (c'est-à dire qui précéde le jeudi) dans la nouvelle lune, (le premier quartier,) du Dschumadi II, et qui dura depuis le commencement de la nuit jusqu'à l'aurore. Il y eut en même temps des tremblements de terre dans le monde entier."—*Tarich el-Mansury, Cod.* 521. *Acad. Sci. fol.* 51*; cited by M. Fraehn, in a communication to the Imp. Acad. Sci. of St. Petersburgh, Dec.* 1, 1837*; quoted in L'Institut, Paris, No.* 252, *p.* 350. *Oct.* 25, 1838.

(14.) A. D. 899. November 14. "In the year 286 (of the Hegira,) there was an earthquake in Egypt, on Wednesday, the 7th of the month Djolkaada, from midnight until morning, and the stars called Schuhub, (luminous meteors,) were in extraordinary commotion, going from east to west, and from north to south, in such a manner that no mortal could look at the heavens."

"Dans l'année 286, il y eut en Egypte, un tremblement de terre le mercredi 7 du mois de Sulkade, depuis le milieu de la nuit jusqu'au matin, et les étoiles qu'on nomme Schuhub, (i. e. le météore lumineux) s'agitèrent d'une manière extraordinaire en se mouvant de l'est á l'ouest et du nord au sud, de façon qu'aucun mortel ne pouvait jeter les yeux sur le ciel."—*Elmacini Histor. Saracen., Arab. et Lat., op. Erpenii*, p. 181, *quoted by M. Fraehn, L'Institut*, No. 252, p. 350.

(15.) A. D. 901. "The whole hemisphere was filled with those meteors called falling stars, the ninth of Dhu'lhajja, (288th year of the Hegira,) [A. D. 901, November 25,] from midnight till morning, to the great surprise of the beholders, in Egypt."—*Modern Part of the Universal History.* 8vo. Vol. 2, p. 281. Lond. 1780.

(16.) A. D. 902. "In the month Djolkaada of the year 289, (of the Hegira,) died king Ibrahim ben Ahmet, and during the same night were seen great numbers of stars, which moved, as if they had been darted through the atmosphere, from a culminating point, and rushed down on the right and left, like rain. On account of this phenomenon, this year was called the year of stars."

"Dans la lune Dylcada de l'année 289, mourut le roi Ibrahim ben Ahmet, et dans le même nuit, on vit un nombre considérable d'étoiles, qui comme si elles eussent été lancées dans les airs, partaient d'un point culminant et se précipitaient à droite et à gauche sous forme de pluie. C'est à cause de ce phénomène que cette annèe a pris le nom d'*Année des étoiles.*" *Conde: Hist. de la Domination des Maures en Espagne*, I, 397, *quoted by M. Fraehn*, (as above,) *who states that the date is the* 24*th or* 25*th October*, A. D. 902. *First quoted in part by Von Hammer*, Comptes Rend. Acad. Sci., 1837, I, 293.

The following probably refers to the same occurrence: "Anno Dominicæ Incarnationis 902, urbs Tauromenis a Sarracenis capta est. Eodem anno in nocte visi sunt igniculi in modum stellarum per aera discurrentes: qua nocte Rex Africæ residens super Cosentiam Calabriæ civitatem, Dei judicio, mortuus est."—*Chronicon Romualdi II*, *Archiepisc. Salernitani:* in *Muratori*, *Rer. Ital. Scr*. t. vii, p. 160.

(17.) A. D. 912 or 913. "I will here add what I have seen in a commentator on the Astronomical Aphorisms of Ptolemy, the last of which begins thus: 'Shooting stars indicate dryness of the air; if they all go towards the same quarter of the heavens, they foreshow winds which will blow from that quarter, but if they scatter in all parts of the heavens they indicate the drying up of the water, disturbances in the atmosphere, and the incursions of armies moving in various directions.' The commentator remarks, 'I remember that in the year 290 [of the Hegira, beginning Dec. 4, A. D. 902] there were seen in Egypt burning meteors which scattered themselves through the sky and filled the whole expanse; they caused great terror and increased continually.* A short time after, a great dearth of water was felt in this country: the Nile rose only thirteen cubits, and violent disturbances arose which caused the ruin of the dynasty of the Toulounis in Egypt. In the year 300 [beginning Aug. 17, A. D. 912] the same phenomena were seen in all parts of the sky; the flow

* If the dates are correct, this must be a case different from No. (16.)

of the Nile was bad, and there were troubles and agitations in the country.' These are doubtless very strong signs, but they are common to all regions; and not peculiar to Egypt. We have seen a recurrence of the same phenomena in the present year 596, [beginning Oct. 22, 1199.] At the beginning of the year, the stars were seen coursing through the heavens, and afterward the water was very low. During the same year the sovereign of Egypt was dethroned by his uncle Melic-aladel."—Translated from "*Relation de l'Egypte, par Abd-allatif, médecin Arabe de Bagdad, etc.; traduit et enrichi de notes historiques et critiques: par M. Silvestre De Sacy.*" Paris, 1810, 4to. book 2, chap. 2, p. 340. *First quoted in part by M. Fraehn*, (sup.)

The passages occur at pp. 117 and 118 of the Tubingen edition of 1789.

(18.) A. D. 931 or 934. "In the same year appeared signs in the heavens among the stars, which appeared some falling and others blazing like torches, on the fourteenth day of October, the second day of the moon."

"934. Indictione 4. Defunctus est Joannes Abbas II Kal. Aprilis, fer. 2. Et in ipso Anno apparuerunt signa in Cœlo de stellis, quæ videbantur hominibus aliæ cadere, aliæ fulgere sicut faculæ XIV die intrante mense Octobri Luna 2."—*Notes found on a Calendar; and printed at the end of Chronicon Cavense:* Muratori, Rerum Italicarum Scriptores. 26 tom. fol. Mediol. 1723, etc. t. vii, p. 961.

The date on the margin is A. D. 934. The year of the Indiction requires A. D. 931: the moon's age agrees about equally well with either.

(19.) A. D. 935. In the year 323, [Hegira,] "several violent shocks of an earthquake were felt in Egypt, the third of Dhu'l-kaada: [Oct. 5, A. D. 935,] about the same time, many of those meteors called falling stars, of a very remarkable kind, likewise appeared in Egypt."—*Modern Part of the Universal History.* 8vo. Lond. Vol. 2. 1780. p. 333. (*Hist. of the Arabs.*)

The following is cited by M. Fraehn: "Le 3 du Sulkade de l'an 323, il y eut en Egypte, un tremblement de terre, et les étoiles lumineuses étaient dans un mouvement violent."—*Eutychii Annal.*, II, 529.

It is plain that the exact date of the shower cannot be inferred from either of these accounts.

(20.) A. D. 1029. "In the year 420, in the month Radjab, [beginning July 16, A. D. 1029,] fell many stars with great noise and very vivid light."

"Dans l'an 420, au mois de Redscheb, il tomba beaucoup d' étoiles, avec accompagnement d'un bruit extraordinaire et de lumières tres vives."—*Soyuti, Hist. Cair. fol.* 338. *First quoted by Von Hammer: Comptes Rend.* 1837, I, p. 293. *Cited also by M. Fraehn.*

Was this a shower of shooting stars, or only the fall of a number of meteoric stones?

(21.) A. D. 1060. In the *Comptes Rendus* of the French Academy of Sciences, (1837, I, 532,) it is stated that M. de Paravey had found in an ancient history of Anjou, an account of a remarkable fall of shooting stars which happened A. D. 1060. The date of the month was not mentioned in the history. It is to be hoped that the passage will be given in full.

(22.) A. D. 1090. "M. Muncke states that in the year 1090, according to the chronicles of that period, shooting stars appeared in considerable numbers, during several consecutive nights."—Trans. *from M. Quetelet's Catalogue des Principales Apparitions d'Etoiles Filantes:* (Brux. 1839,) p. 28; *where reference is made to Gehler's Dict. of Physics*, viii, 1025.

This may possibly be a typographical error for A. D. 1096.

(23.) A. D. 1094. "At this period, so many stars fell from heaven that they could not be counted. In France the inhabitants were amazed to see one of them of great size, fall to the earth, and they poured water on the spot, when to their exceeding astonishment, smoke issued from the ground with a hissing noise."

"A. D. 1094. Rex autem Willielmus [Victor] omnes fines Walliæ hostiliter ingressus * * * Eodem tempore tot stellæ de cœlo cadere visæ sunt, quòd non poterant numerari. Inter quas, cum unam magnam quidem labi in Gallia gens stuperet, notatoque loco, aquam ibi fudisset, fumum cum stridoris sono de terra exire, obstupuit vehementer."—*Matth. Paris Mon. Alb. Angli Hist. major*, etc. fol. Lond. 1640, p. 18.

"The year 1094 was very remarkable for the number and fashion of gliding stars, which seemed to dash together in manner of a conflict."—*Sir J. Hayward, cited in Guthrie's History of England.* fol. 1744. Vol. i, p. 423.

It is not improbable that these events belong to the next year.

(24.) A. D. 1095. April 4. "This year Easter was on the 8th of the Kalends of April. And, after Easter, on the festival of St. Ambrose, that is on the 2d of the Nones [4th day,] of April, over almost all this land and for nearly the whole of the night, stars were seen falling from heaven in manifold ways, not one or two at a time, but so thickly that no man could count them."

"MXCV. On thisum geare wæron Eastron on VIII kl. Apr. And tha uppon Eastron on sce Ambrosius mæsse-niht, that is II Non. Apr., wæs gesewen for-neah ofer eall this land swilce for-neah ealle tha niht swithe mæni-fealdlice steorran of heofenan feollan, naht be anan oththe twam, ac swa thiclice thæt hit nan mann ateallan ne mihte."—*Chron. Sax. ed. Gibson.* Oxon. 1692. 4to. p. 202.

This instance was first quoted, anonymously, from Wilken's History of the Crusades, (*Geschichte der Kreuzzüge*, Leipzig, 1807,) in Comptes Rendus Acad. Sci. (1836, II, 145.) Wilken (th. 1, s. 75,) quotes Baldric's Chronicle, which states that the shooting stars were on that occasion so numerous, "ut grando, nisi lucerent, pro densitate putarentur." The date is erroneously given, April *twenty fifth*, in Wilken. It is thus copied into the Comptes Rendus, from which work the false date has been extensively propagated. Calvisius (Opus Chronolog., etc. fol. Franc. ad Mœn. 1685, p. 743,) also gives the subjoined quotation from Baldric, which shows the origin of the mistake. The moon was in fact in the twenty fifth day of the lunation, on the 4th day of the month of April of that year. Notices of this great meteoric shower are found in many different authors, some of which are given below. Its exact date is most satisfactorily determined.

"1095. Stellæ in cœlo die 4. April. fer. 4, Lunâ 25, visæ sunt inter se pugnare, in tanta frequentia, ut numerari non possent."—*Baldricus.*

"Anno autem Dominicæ Incarnationis millesimo nonagesimo quinto, Indictione tertia, pridie Nonas Aprilis, quartâ feriâ post octavas Paschæ, à quarta ferme vigilia noctis, usque in crepusculum, stellæ innumerabiles de cœlo, versus occidentalem plagam, ubiq. terrarum cadere visæ sunt."—*Chron. Sac. Monast. Casin.*; in Muratori *Rer. Ital. Scr.* t. iv, p. 497.

1094 ["verius 1095"] Ind. II. mense Aprilis Urbanus Papa Placentiæ Synodum celebravit et IV Nonas ejusdem mensis Aprilis fuit terribile signum in stellis, ita quòd a mediæ noctis tempore usque manè visæ sunt innumeræ stellæ mixtim ex omni parte Cœli decurrisse, et in terram decidisse.—*Romualdi Salern. Chron.*, in Muratori, *Rer. It. Scr.* t. vii, p. 177.

Anno 1095, mense Aprilis in nocte diei 4, subito visi sunt igniculi cadere de cœlo, quasi stellæ per totam Apuliam, qui repleverunt universam superficiem terræ, et ex tunc cœperunt Galliæ populi, imò totius Italiæ pergere ad sepulchrum Domini cum armis ferentes in humero dextro Crucis signum.—*Lupi Protospatæ Rer. in Reg. Neapol. Gest. Chron.*, in Muratori, *Rer. It. Scr.* t. v, p. 47.

1095. Pridie Nonas Aprilis visæ sunt in nocte stellæ, quasi de cœlo cadere.—Rog. de Hovenden, *Annales, pars prior.* fol. Lond. 1596. fol. 266.

(25.) 1096. "During many nights stars were seen to rain down at intervals, but so thick and fast, that one would have said they were flakes from the celestial orbs."

"On vit durant plusieurs nuits pleuvoir des Etoiles par intervales, mais si dru et menu, qu'on eût dit que c'étoient des bluettes du débris des orbes célestes."—*De Mezeray: Abrégé Chronologique de l'Hist. de France.* Amst. 1755. 4to. t. ii, p. 156.

"In 1096 nono [Qu. nonis] Aprilis in Depositione Sancti Ambrosii, [Aprilis 4?] visæ fuerunt in multis locis frequenter in illa nocte stellæ, quæ ceciderunt de cœlo, et in Ascensione Domini, quæ fuit in illo et eodem anno, et in festivitate Sancti Ambrosii cecidit magna nix."—*Chron. Parmense*, in Muratori, *Rer. It. Scr.* t. ix, p. 760.

Chladni has mentioned the meteors of this year, (*Feuer-Meteore*, pp. 88, 89,) referring for authority to *Historiæ francicæ fragmentum;* in Duchesne: *Hist. Franc. Script.* t. iv, p. 90.*

(26.) A. D. 1106. "On the twelfth of February, at Bari, a town in Italy, were seen by day several stars in the sky, sometimes apparently running together, and sometimes apparently falling to the earth."

"Pridie idus Februarii apud Barum Italiæ oppidum conspectæ sunt aliquot stellæ in cœlo per diem, nunc quasi inter sese concurrentes, nunc quasi in terram cadentes."—*Hist. Eccl. Magdeb.* tom. vi, p. 1712.

* In (Short's) *Genl. Chr. Hist. of the Air*, &c., it is said that in A. D. 1099, "many frightful prodigies were seen: * * * stars seemed to fall to the earth, &c." Vol. 1, p. 104.

"A comet was visible in February, from 3 o'clock to 9 for twenty five days at the same hour. * * * In Judea this comet was seen fifty days decreasing. * * * Shortly after the Stars seemed to rain down from Heaven."—*Clark's Mirrour.*—[*Short's*] *Gen. Chron. Hist.* of the Air, &c. Vol. I, p. 107.

The following passage (nearly identical with that above given,) is quoted from Schnurrer's *Die Krankheiten des Menschengeschlechts*, 1825, (Bd. 1, s. 230,) by M. A. Erman, in *Poggendorff's Annalen der Physik*, B. 48, s. 585, (1839.)

"Anno 1106, pridie Idus Februar. apud Baram Italiæ stellæ visæ sunt in cœlo per diem, nunc quasi inter se concurrentes, nunc quasi in terram cadentes."

The foregoing is cited by Erman in support of his hypothesis that the meteoric stream from which are derived the shooting stars which at the present time are seen about the 10th of August, intervenes between the earth and sun about the 6th of February. The account does indeed seem to assert that the meteors were seen in the day time, but it is evident that unless they were at least as brilliant as the planet Venus, they would not be visible in such circumstances. There was no eclipse of the sun on this day. Perhaps the story may be cleared up by reference to the *Annales Boicorum* of Aventinus, from which many fearful prodigies are quoted in the Magdeburgh Ecclesiastical History, as happening at this time. Without the quotation from *Clark's Mirrour*, it would be doubtful whether the number of meteors seen at this time was larger than usual.

(27.) A. D. 1122. April 4. In the year of our Lord 1122, on the day before the nones of April, at the fourth watch of the night, while the brethren were chanting the Synaxis nocturnalis, innumerable stars were seen falling, and as it were raining down, throughout the world."

"Hoc interea tempore, anno Dominicæ Incarnationis ejus millesimo centesimo vicesimo secundo, pridie Nonas Aprilis, quarta vigilia noctis, cum Fratres nocturnalem Synaxim decantarent, stellæ de Cœlo innumerabiles cadere, et quasi pluere visæ sunt, ubique per totum orbem terrarum."—*Chronica Sacri Monasterii Casinensis*, lib. 4, cap. lxxix, in Muratori, *Rer. It. Scr.* t. iv, p. 546.

1122. Stellæ innumeræ quasi pluere visæ sunt pridie Non. Aprilis horâ matutinâ.—*Anonymi Monachi Cassinensis Breve Chronicon;* in Muratori, *Rer. It. Scr.* t. v, p. 61.

1122. Indictione decimaquinta Stellæ innumerabiles visæ sunt cadere per totum orbem pridie . . . . Aprilis hora matutina.—*Chron. Fossæ Novæ*, in Muratori, *Rer. It. Scr.* t. vii, p. 868.

(28.) A. D. 1199. "At the beginning of the year [596 of the Hegira, commencing Oct. 22, 1199] the stars were seen coursing through the heavens, &c." See quotation from Abd-allatif's Account of Egypt, under No. (17.)

(29.) A. D. 1202. In the year 599, on the night preceding Sunday the last day of the month Moharrem, [October 19, A. D. 1202,] the stars rushed across the heavens from east to west, and glided to the right and left, like grasshoppers in a field. This continued until dawn. The inhabitants cried out with terror, and fervently implored the mercy of the Most High. A similar occurrence happened in the year of the holy mission of the Prophet, [A. D. 611,] as well as in the year 241, [A. D. 855.]

"En l'an 599, dans la nuit du dimanche, dans le dernier jour du Muharrem, les étoiles s'élancèrent au ciel dans une direction de l'est à l'ouest, et s'échappèrent ça et la tant à droite qu'à gauche, comme des sauterelles sur un champ. Ceci dura jusqu'à l'aurore. Les hommes jetèrent des cris d'épouvante et implorèrent à grand cris la misericorde du Tres-Haut. La même chose, au reste, avait eu lieu dans l'année de la sainte mission du Prophète, ainsi que dans l'année 241."—*Soyuty's Hist. of Cairo*, fol. 342, *quoted by M. Fraehn*, (as above.) *First cited in part by Von Hammer*, *Comptes Ren. Acad. Sci.* 1837, I, 294.

"Au commencement de l'an 599 on vit à Bagdad les étoiles tomber çà et là, et comme des sauterelles s'élancer d'un lieu dans un autre. Celá dura jusqu'à l'aurore. Les hommes poussèrent des cris et implorèrent par des prières le Dieu tout puissant."—*Scheby, in T. Duwel el-Islam. Cod. Acad. Sci.* No. 254. *Cited by M. Fraehn.*

"Dans l'année 599 on vit un mouvement d'oscillation des étoiles pendant toute la nuit du dernier [jour] de Muharrem."—*Haddschy Chalfa, Chronological Tables. Cited by M. Fraehn. L'Institut*, No. 252.

(30.) A. D. 1243, July 26. "In this year, on the 7th of the Kalends of August, the night was most serene and the air exceedingly pure, so that the milky way was as manifest as in the clearest winter night, although the moon was in her eighth day. And to our surprise, stars were seen falling from heaven, swiftly darting on all sides. * * * Most remarkably, thirty or forty were seen to shoot or fall at the same instant, so that two or three would fly together in the same track. Of course, if these had been real stars, (which no man of sense supposes,) not one would have been left in the sky. It belongs to the astrologers to interpret this portentous appearance; but to all the beholders it was a most stupendous and wonderful spectacle."

"Et eodem anno, videlicet septimo Calend. Augusti, fuit nox serenissima, aërque purissimus, ita quòd Lactea, sicut solet placidissima nocte hyemali contingere, manifestè apparebat, Luna existente octava. Et ecce stellæ cadere de cœlo videbantur, velociter sese jaculantes hac et illac. Non tamen, ut de more contingit, quædam faculæ per modum stellarum subruentes (quod, sicut determinatum est in libro Metheorum *Aristotelis*, naturaliter contingit,) sicut fulgur ex tonitru: sed in uno instanti, præter solitum, triginta vel quadraginta saltitare vel cadere viderentur, ita scilicet, quòd duæ vel tres simul uno tramite, volare se mentirentur. Unde, si veræ stellæ fuissent (quod nullius sapientis est sentire) nec una in cœlo remansisset. Considerent Astrologi, quid hujusmodi portentum significet; sed omnibus intuentibus, videbatur nimis stupendum et prodigiosum.*—*Matt. Paris Mon. Alb. Angli Hist. Major.* fol. Lond. 1640, p. 602.

"1243. Eodem mense [i. e. Julii] discursus Siderum de nocte visus est in Festo Sancti Jacobi [26to.] ita ut unum contra alterum quasi hostem insurgerent, et inter se hostiliter dimicarent."—*Ric. de St. Germano Chronicon,* in Muratori, *Rer. It. Scr.* t. vii, p. 1052.

(31.) A. D. 1366, Oct. 22. "In the year 1366, on the day after the festival of the eleven thousand virgins, [Oct. 22,] from midnight until daylight, stars were seen falling in streams from heaven, and in such multitudes that no man could count them."

"Eodem anno (i. e. 1366) die sequenti post festum XI millia virginum, ab hora matutina usque ad horam primam† visæ sunt quasi stellæ de cœlo cadere continua [continue ?] et in tanta multitudine, quod nemo narrare sufficit."—*Chronicon Ecclesiæ Pra-*

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* This quotation was published in my paper of November, 1837, (this Jour. Vol. 33, p. 358.)

† The hour of *matins* ranged between midnight and one o'clock in the morning; the *prime* began at day break or sometimes at sunrise. There is no reason to suppose that this display was seen in the day time.

gensis.—Script. Rer. Bohem. pars II, p. 389. Prag. 1784. Quoted by Boguslawski, Jr. in *Poggendorff's Annalen der Physik und Chem.* B. 48, s. 612, 1839.

(32.) A. D. 1398. "Many stars of a fiery appearance fell down. At this time pestilence invaded nearly the whole of Italy."

"Anno Domini MCCCLXXXXVIII. Multæ stellæ ad modum ignis ceciderunt, quas Asub vocant. Tunc pestis totam fere Italiam invasit."—*Annales Forolivienses*, in Muratori, *Rer. It. Scr.* tom. xxii, p. 200.

(33.) A. D. 1399. "An eclipse of the sun happened on the second of the Calends of October. [Sept. 30.] Stars like fire were also seen falling from heaven in many parts of Italy."

"Anno Domini MCCCIC. Eclipsis Solis facta est secundo Calend. Octobris. Stellæ quoque instar ignis de cœlo cadentes in plerisque Italiæ locis visæ sunt."—*Annales Forolivienses*, in Muratori, *Rer. It. Scr.* t. xxii, p. 200.

(34.) A. D. 1635, 1636. "During the whole summer of 1635, no less than during that of 1636, signs of this sort were seen, viz. burning stars running together in the heavens in great numbers and falling to the earth."

"Hujus quoque generis varia signa pestem Noviomagensem prænunciare visa sunt: Tota enim æstate anni 1635, non minus quam anni 1636, hujusmodi indicia se prodiderunt: Nempe, stellarum ardentium in cœlo oberrantium magnus concursus, et in terram prolapsio."—*Diermerbroeck*: *Op. omnia.* fol. Ultraj. 1685: *De Peste*, p. 10. Quoted in *Webster's Hist. Epidem. and Pestilen. Diseases*, Vol. 2, p. 89.

If this is to be interpreted literally, it must be considered an extravagant account. In (Short's) *Gen. Chron. Hist. of the Air*, &c., is the following statement, (the time of year being uncertain,)—"From March to August, 1636, not one drop of rain. This Numigen plague raged most at new and full moon. It was presaged by great Justling and Falling of fiery Stars south or west, many fewer birds than ordinary, &c."—Vol. I, p. 314.*

* Rev. W. B. Clarke, in Loudon's Mag. Nat. Hist., 1834, Vol. 7, p. 294, states that, "On August 18, 1716, meteors were seen all over Europe, from 8 P. M. to 3 A. M."—"On January 4, 1717, there was a shower of fire at Quesnoy."—The first case is probably a display of the aurora borealis: the latter was probably a lightning-bolt, or possibly a large meteoric fire-ball.—(*Hist. de l'Acad. de France*, 1717, p. 8, II.)

(35.) A. D. 1743. October 4. "A clear Night, great Shooting of Stars between 9 and 10 a Clock, all shot from S. W. to N. E. [Qu. N. E. to S. W.] one like a comet in the Meridian very large, and like Fire, with a long broad Train of Fire after it, which lasted several minutes; after that was a Train like a Row of thick small Stars for twenty Minutes together, which dipt N."—*General Chronological Hist. of the Air, Weather, &c.* [by Dr. Thos. Short.] Lond. 1749. 8vo. Vol. II, p. 313.

The dates of the catalogue thus far, are of the Julian style: those which follow, are of the Gregorian.*

(36.) A. D. 1799. November 12. A great shower of shooting stars, seen chiefly between midnight and morning, in various parts of Europe and America. The light of the moon (then at the full,) greatly impaired the splendor of the display.—*Ellicott's Journal.* 4to. 1814. p. 248.—*Humboldt: Voyage*, tom. 4. liv. 4. ch. 10. 8vo.—*Gilbert's Ann. der Physik*, Bd. 6: 191, 12: 217, 15: 109.

(37.) A. D. 1803. April 20. A great shower of shooting stars after midnight, seen in the northern and middle portions of the United States. Sky clear and moon only a few hours before the change.—*This Jour.* Vol. 36, p. 358.†

(38.) A. D. 1832. November 13. An extensive shower of shooting stars seen between midnight and morning, in various and widely distant parts of the globe. The moon (five days past the full,) much diminished the brilliancy of the spectacle.—*Bib. Univ. de Genève.* 1832; t. 3: 189.—*Comptes Rend.* vi. 562.

(39.) A. D. 1833. November 13. A great shower of shooting stars seen between midnight and morning in various parts of

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* In this catalogue I intend to confine myself to *showers* of shooting stars, and omit many instances, occurring chiefly in August, in which meteors have been seen in uncommon, but not very large numbers. Of these meteoric displays some may perhaps merit a place in this list, e. g. those of Aug. 9, 1779, Aug. 9, 1798, Dec. 6, 1798, and Aug. 9, 1837. An extensive collection of these cases is given by M. Quetelet in his *Catalogue des Principales Apparitions des Etoiles Filantes*, (4to. Bruxelles, 1839.) It may be well to restrict the term *meteoric shower* to those instances where the meteors appear at a rate not less than 1000 per hour.

† In E. H. Burritt's *Geography of the Heavens*, (12mo. 1838, p. 161,) it is said, "a shower of stars exactly similar took place in Canada between the 3d and 4th of July, 1814, and another at Montreal, in Nov. 1819." "Another was witnessed in the autumn of 1818, in the North Sea, &c." Probably neither of these occurrences was a shower of shooting stars. On the 3d and 4th of July, 1814, there fell on the river St. Lawrence, Canada, a quantity of dust or ashes, the air being very hazy and smoky.—*Tilloch's Phil. Mag.* Lond. 44: 91. That of 1818, was doubtless a display of the aurora borealis.

North America. The meteors appeared to diverge from the vicinity of γ *Leonis*, and were most abundant about 4 A. M. Sky clear and moon in the second day past the change.—*This Jour.* Vols. 25, 26, &c.

Recapitulation: dates reduced to Gregorian style.

1.	B. C.	1768.	14.	A. D.	899. Nov. 18.	27.	A. D.	1122. April 11.
2.	"	686.	15.	"	901. Nov. 30.	28.	"	1199. Oct.?
3.	A. D.	7.	16.	"	902. Oct. 30.	29.	"	1202. Oct. 26.
4.	"	532.	17.	"	912 or 913.	30.	"	1243. Aug. 2.
5.	"	558.	18.	"	931 or 934. Oct. 19.	31.	"	1366. Oct. 30.
6.	"	585. Sept. 6?	19.	"	935. Oct.?	32.	"	1398.
7.	"	611.	20.	"	1029. July or Aug.	33.	"	1399. Oct.?
8.	"	744 or 747.	21.	"	1060.	34.	"	1635, 1636.
9.	"	750.	22.	"	1090.	35.	"	1743. Oct. 15.
10.	"	764.? March.	23.	"	1094.	36.	"	1799. Nov. 12.
11.	"	765. Jan. 8.	24.	"	1095. April 10.	37.	"	1803. April 20.
12.	"	829.	25.	"	1096. April 10?	38.	"	1832. Nov. 13.
13.	"	855. Oct. 21.	26.	"	1106. Feb. 19.	39.	"	1833. Nov. 13.

The limits prescribed to this paper will permit only a very brief discussion of the preceding catalogue. The region of country included by these showers, down to that of A. D. 1799, extends from England to China, about 130° in longitude, and from about 20° to 51° N. latitude. The table above shows the dates (whenever they could be found,) reduced to the Gregorian calendar, which, thus stated, will indicate with sufficient accuracy the point of the earth's orbit, in each instance intersected by the meteoric stream. It is reasonable to presume that some of the dates are erroneous, and that some of the cases were not actually meteoric *showers*. Much caution is therefore necessary in tracing the correspondence of dates between these ancient star-showers and those of the present age, especially as our knowledge is so imperfect regarding the meteoric seasons which now exist. The shower of April 20, 1803, may be the lineal successor of those of April 10, 1095 and 1122. That of August 2, 1243, may be the ancestor of the meteoric sprinklings of August 10, seen at the present day. It does not appear certain which of these ancient showers is represented by the modern shower of November 13. There is some reason to suppose that those showers which are described as continuing all night, (e. g. Nos. 4, 5, 9,) may have occurred in the summer season.

Previous to 1833, we have no precise observations on the position of the point of *radiation* during any meteoric shower, but some slight indications that such radiant was noticed, occur in Nos. 14, 16, 29, 35. No comparison as to this particular can be made between the ancient and the modern meteoric displays.*

If the foregoing catalogue comprised all the star-showers that have ever occurred, it would be easy to determine the *cycle* of the shower of any particular date. In the present state of our knowledge, it may be inferred that the cycle of the November shower is about *thirty four* years. There is of course some ground for expecting about the year 1867, a recurrence of the splendid displays of November 13, 1832 and 1833. It is remarkable that Humboldt mentions that the earthquakes of 1766 in South America, were preceded by phenomena like those of November 12, 1799. I have searched several American newspapers of the former period, but find no trace of any such meteoric display in the United States. The cycle of the April shower may be about *twenty seven* years; but it does not appear that any unusual number of meteors was seen in April, 1830. It is, however, not to be supposed that the cycle remains constant through successive ages.

A just theory of shooting stars must explain all the meteoric showers enumerated in the foregoing list, so far as they are truly stated. It must likewise account for all the meteoric seasons which exist at the present time, and also for the shooting stars of daily occurrence, which, taking into view the whole globe, are exceedingly numerous. The most probable hypothesis is, that there are revolving around the sun, millions of small planetary and nebulous bodies, of various magnitudes and densities; and that when any of these dart through our atmosphere, they become ignited and are seen as *shooting stars*. To ascertain the mode in which they are arranged in the solar system, is an important object of inquiry. A *single* zone or ring of such bodies is insufficient to account for all the known phenomena.

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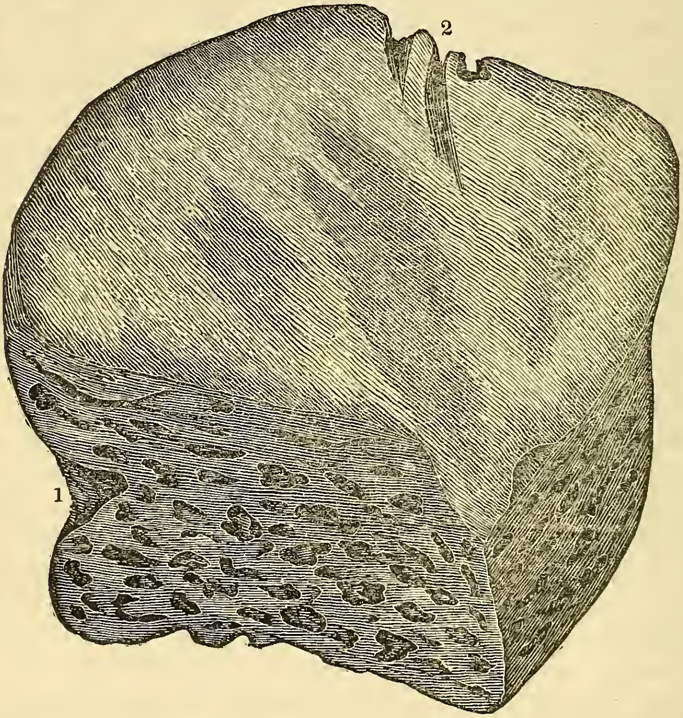
* The following passage from Ptolemy (differing somewhat from that quoted under No. 17,) deserves notice here, as showing that observations upon the directions of shooting stars were not unknown in his time.—"Discursiones et jaculationes stellarum si ab uno angulo prorumpant, inde quoque ventum emittunt. Sin occurrant inter se, ventorumque prælia suscitant. Sin vero de quatuor plagis ruant, hyemes varias ferunt, atque etiam fulmina, tonitrua, et quæ alia hujusmodi sunt."—*Claud. Ptol. lib. de judiciis, interp. J. Camerario*, fol. Basil. 1551, p. 403.

Art. XI.—*On Native and Meteoric Iron;* by Charles Upham Shepard, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

Native Iron from near Oswego, N. Y.

While at French Creek, Jefferson county, N. Y., during the last summer, I was informed by Capt. Hugernin, of that place, of the existence of a mass of native iron at Oswego, which had for several years been in the possession of an individual there, by whom it had been preserved, under the impression that it was



of meteoric origin. Aided by directions from Capt. H., I had no difficulty, when passing through Oswego a few days after, in finding the person in whose hands the specimen was still remaining. This individual was Mr. Philander Rathbun, a highly intelligent and respectable blacksmith. He very liberally presented me the mass, upon the conditions of my devoting to it a careful examination, and reserving for him a slice of it, sufficiently large to enable him to gratify the very rational curiosity he possessed of working under the hammer, an iron which he was satisfied differed very considerably from the metallic iron of the arts.

The mass was found in the town of Scriba, four miles east of Oswego, about five years ago, by a man by the name of Julius Rust, who was in the habit of furnishing Mr. Rathbun with charcoal. It was discovered in digging up the soil, which had been the foundation of an old coal-pit. Its weight is about eight pounds; and its general aspect, of which some idea may be formed by the annexed figure, is wholly opposed to the supposition of its being a product of the forge. Indeed no iron works of any description have ever existed in this region. It approaches the cube in shape, though all its angles and edges are more or less rounded, while its upper surface is sub-spherical, and nearly smooth. The sides and base, on the contrary, are much pitted by irregular concavities, which give a surface most resembling on the whole, the ripple produced on a calm sea by the first access of a gentle breeze. The arrangement of these depressions and elevations upon the sides of the mass, is such, as to give obscure lines or waves parallel to the edges of the base. This appearance taken along with the more flattened shape of the base, led Mr. Rathbun to imagine that the mass had fallen from the heavens, in a plastic condition, and that its present figure is partly accounted for, by its striking the earth on that side, which is here described as the base.

With the exception of a few impressions made in two or three places by the cold chisel, for the purpose of detaching little fragments by Mr. R. there is no trace pertaining to it, of any human workmanship. But its most singular feature consists in its having several re-entering angles, (see 1 and 2,) about its edges, which are closely packed with a hard, black and brittle ore, whose color and lustre approach to those of Borrowdale plumbago. No part of the specimen exhibited any accumulation of rust. Its color, where a fresh surface had not been exposed, was iron-black. The fresh surface is light steel-grey. The texture is exceedingly fine, and when polished, the lustre is high.

On my return to New Haven, I employed a skilful machinist, who had been accustomed to the slitting of meteoric iron, to make a number of sections from one side of the mass. In per-forming this operation, he observed that its hardness was less in amount, and more uniform in its nature, than that of the Texian meteoric iron, while it differed no less strikingly in other respects, from any artificial iron with which he was acquainted. He noticed in particular, that it possessed an unusual degree of toughness. Its specific gravity is 7.50.

Ammonia was added in excess to the slightly warmed, nitro-hydrochloric solution of this iron, and the fluid shortly after cleared from the precipitated sesquioxide of iron: this fluid was destitute of any tinge of blue, nor did it yield a precipitate when treated with the hydrosulphate of ammonia. Neither nickel or cobalt can therefore enter into the composition of this iron.

In the next place, I detached, with considerable difficulty, enough of the brittle plumbago-looking mineral above alluded to, to discover in it the following properties: hardness $=5.0\ldots5.5$: specific gravity $=5.2\ldots5.4$; brittle: color dark iron-black: streak similar, except a tinge of brown: lustre imperfectly metallic: fracture uneven to granular; a portion of it is magnetic, while the rest is not taken up by the magnet. Heated before the blowpipe, in thin fragments, it does not fuse, but becomes somewhat rounded on the edges; after heating, it is strongly magnetic. It slowly entered into solution in nitro-hydrochloric acid, excepting a few flocks of silicic acid. No traces of either nickel or cobalt were present in the solution.

It is only very recently that I have had it in my power to resume the investigation of this singular specimen of iron. I am unable to detect in it either of the following principles, to wit, lead, tin, manganese, copper, titanium, silver, sulphur or phosphorus.

The precipitated peroxide of iron, on digestion with a solution of potassa, and subsequent treatment with hydrochlorate of ammonia, gave only a faint troubling from alumina.

The clear fluid, from which the iron and alumina were precipitated, gave with oxalate of ammonia, a distinct, but feeble precipitate of oxalate of lime.

The solution of the iron in hydrochloric acid, as well as in sulphuric acid, gave an impalpable, heavy, black, plumbaginous looking matter, which on being ignited alone, suffered no change in color. It was heated to redness along with carbonate of potassa, the mass was treated with water, and hydrochloric acid, whereupon silicic acid made its appearance.

The iron afforded me the following results:

Iron, - - - - - -	99.68
Silicon, - - - - - -	0.20
Calcium, - - - - -	0.09
Aluminium, in traces, - - -	
	99.97

The hard and brittle ore attached to the mass, does not appear to differ essentially from ordinary magnetic iron ore. It contains traces of silicic acid and of lime.

The source of this iron, must probably for the present, remain a subject of doubt. The secondary country in which it was found, no less than the peculiar configuration of the mass, would lead us to doubt its terrestrial origin, either as a product of nature or of art; while the absence of nickel in its composition, separates it widely from meteoric iron. Future observations may relieve it from the isolated position it now appears to hold.

Meteoric Iron from Guilford County, North Carolina.

In the year 1830, I gave, in Vol. xvii, p. 140, of this Journal, a hasty notice of two small fragments of iron from North Carolina, which had been presented to the American Geological Society, by Prof. D. Olmsted, of Yale College. Having had occasion to bestow a renewed attention to the subject recently, I find I had adopted an erroneous opinion respecting the specimen from Guilford County. It contains both chlorine and nickel; and consequently can no longer be regarded as possessed of terrestrial origin.

The structure of this iron, as developed by the recent attempt to detach a few grains for analysis, reminds me forcibly of that exhibited by the Buncombe, (N. C.,) meteoric iron. Like this, it cleaves into tetrahedral, octahedral, and rhomboidal fragments, and presents the same foliated texture, and pinchbeck tarnish. It cleaves, however, with greater difficulty than the Buncombe iron.

In effecting its solution in nitro-hydrochloric acid, I observed a very slight residuum of a greyish black color. It was removed from the solution, and finely pulverized in a mortar. It presented the appearance of magnetic iron, and on treating it with a concentrated portion of the mixed acids, it entered into solution after the manner of this ore. Peroxide of iron was thrown down on the addition of ammonia to the solution.

Water boiled in contact with the iron, afforded, when treated with nitrate of silver, a copious precipitate of chloride of silver. Faint traces of cobalt were also detected in the iron. But the small quantity of the mineral at my command, prevented me from attempting to estimate the proportions of these ingredients. The same reason also precluded the search after other principles often found in meteoric iron. The following presents the results obtained :

Iron, - - - - - -	92.750
Nickel, - - - - - -	3.145
Magnetic iron ? - - - -	0.750
	96.645

Charleston, S. C., Feb. 3d, 1841.

Art. XII.—*On the First, or Southern Coal Field of Pennsylvania;* by M. Carey Lea.

Among the numerous sources of wealth possessed by Pennsylvania, are her inexhaustible iron mines and coal beds. It must be acknowledged by all, that they constitute her true wealth, and they will contribute greatly to elevate her in the scale of national prosperity.

Her coal beds are peculiarly valuable, possessing as she does, every variety of this fuel, from the hardest *anthracite*, to the most highly charged *bituminous coal.* She can supply those kinds most suitable for economical purposes, for generating gas, for making and working iron, in a word, for all the many uses to which this substance is applied. It is chiefly to her mines that the steam navigation of the Atlantic coast must look for its supplies, and the quantity thus consumed, though at present it may appear inconsiderable, will probably be soon enormously increased.

It has been the opinion of my father for many years, that the hard or highly carbonized anthracite of the eastern end of the Southern Coal Field, changes to the bituminous in the western end, by nearly regular gradations, the veins probably being continuous from the one point to the other. A case analogous to this is presented by the anthracite and bituminous coal of South Wales.

With a view of testing this opinion, and for other purposes, a laborious set of analyses was undertaken, from specimens known to be authentic, in the laboratory of Prof. Booth. The method of analysis pursued was the following. One gramme of the coal, reduced to a fine powder in an agate mortar, was carefully and gradually heated, in a platina crucible having but one small aperture, in order to drive off the volatile matter. When this was effected, the residuum was weighed, and the volatile matter thus ascertained. The crucible was then exposed to the highest heat of an alcohol blowpipe for some hours, until the carbon was thoroughly burnt out, and the ash was then weighed. The ash and volatile matter subtracted from 1.000 gave, of course, the carbon.

It must be borne in mind that the analyses of the various coals from the Dauphin and Susquehanna Coal Company's lands, were made from specimens taken from explorations of veins, near the surface, and should therefore be considered in a great measure as crop coals.

*Analyses.**

No. 1. *Lehigh.*—The farthest eastern point at which coal is worked, is that owned by the Lehigh or Mauch Chunk Coal Company. The specimen of this coal examined was very pure, and of very conchoidal fracture; it was broken with difficulty and flew very much under the strokes of the pestle. Its color was a deep, brilliant black, with very narrow parallel lines of a still deeper color. It was a long time in burning and left a light fleecy ash of a very white color.

No. 2. *Tamaqua.* Little Schuylkill Coal Co.'s Mines.—This is the next important mining station, west of the Lehigh. The specimen was very brilliant with a somewhat conchoidal fracture, and so hard that white paper rubbed on a fresh fracture was scarcely marked by it. Its ash was greyish white and flocculent.

No. 3. *Pottsville.* Black Mine Vein.—Next in order is the Pottsville coal. The specimen examined was of a fine brilliant appearance and very refractory. It came from the Black Mine vein, two hundred feet below water level, and contained layers of a darker and softer substance without any splendor, and by these it usually fractured. Ash deep red.

* The analyses have been condensed into a tabular form for greater economy of room and perspicuity; the Nos. will be found to correspond with the table.—*Eds.*

No. 4. *Pinegrove.*—A specimen of this coal, from the "North Seam," three fourths of a mile north of Sharp Mountain, was submitted to examination. It was brilliant, exhibited a conchoidal fracture, and was refractory under the hammer. Ash reddish yellow.

No. 5. *Black Spring Gap*, 26 miles from the Susquehanna. Fish-back Vein.—This is the next western point at which coal is worked, and from it, specimens of two veins were examined, this and the following. This one is devoid of lustre, and after burning, leaves a yellowish red ash.

No. 6. *Black Spring Gap.* Peacock Vein.—The coal from this vein was brilliant, with a conchoidal fracture, and leaves a yellowish red, very light ash.

No. 7. *Gold Mine Gap*, 25 miles from the Susquehanna. Peacock Vein.—This coal is brilliant, possessing a conchoidal fracture. Its ash was yellowish red, very bulky and light.

No. 8. *Rausch Gap*, 21 miles from the Susquehanna. Pitch Vein, west side.—The specimen from this vein was rather friable. Its fracture was somewhat conchoidal, and generally brilliant. Ash yellowish red.

No. 9. *Rausch Gap.* Pitch Vein, east side.—This coal is hard and rather brilliant, leaving a deep red ash, which changes to yellowish brown by a day's exposure to the air.

It will be seen that the portions of volatile matter in the two last are very nearly equal. The difference in the hardness and in the ash, probably results from the one specimen having been taken from nearer the crop than the other.

No. 10. *Yellow Springs Gap*, 16 miles from the Susquehanna. Back-bone Vein.—This specimen possessed but little lustre and left a dark red ash.

No. 11. *Yellow Springs Gap.* Vein next north of Central Ridge.—This is a dense, black coal, which cokes. Its ash is pale salmon color.

No. 12. *Rattling Run Gap*, 13 miles from the Susquehanna. Perseverance Vein.—The specimen analyzed was brilliant, with a clear, bright fracture, and burned with a bright flame. Its ash was dark red.

This terminates our series, being the last important coal station where a vein fit for working has been discovered, so far as exploration has gone on.

It would appear from these results, that the bituminous qualities of the coal increase with considerable regularity from Tamaqua to Rattling Run, that from Mauch Chunk being an exception, although its excess of volatile matter may probably be attributed to its containing a larger proportion of water.

Specimens of two other American coals, were examined for comparison with the preceding. These were from the Blossburg or Tioga mines, and from Cumberland, Md.

No. 13. *Tioga.*—The Tioga Coal Field is a detached portion of the eastern extremity of the Great Allegany Coal Basin. The specimen examined was of a medium hardness, and its fractures were sometimes brilliant, sometimes altogether devoid of lustre. Its ash was cream-colored, inclining to grey.

No. 14. *Cumberland, Md.*—This coal is brilliant, with an even fracture, and cream-colored ash, passing to grey.

No. 15. *Black Spring Gap.* Grey Vein.—This remarkable vein, as mentioned by R. C. Taylor, Esq. in his "Report of the Stony Creek Coal Estate," is about seventeen feet thick, containing much fine coal, with a vein near the centre, two or three feet thick, of coal of a greyish color, which has given the name to the whole. The specimen of this included vein, in my possession, closely resembles plumbago in appearance. It burns with little flame, leaving a yellowish red ash.

Table of analyses of coals from Pennsylvania. The numbers refer to those prefixed to the paragraphs.

No.	Locality.	Carbon.	Volatile matter.	Ash.
1.	Lehigh, - - - - -	.870	.073	.057
	Another analysis of the same gave,	.869	.075	.056
2.	Tamaqua, - - - -	.910	.055	.035
3.	Pottsville, - - - -	.884	.068	.048
4.	Pinegrove, - - - -	.859	.072	.069
5.	Black Spring Gap. Fish-back vein,	.840	.065	.095
6.	Black Spring Gap. Peacock vein,	.886	.071	.043
7.	Gold Mine Gap. Peacock vein,	.830	.090	.080
8.	Rausch Gap. Pitch vein, west side,	.771	.109	.120
9.	Rausch Gap. Pitch vein, east side,	.789	.110	.101
10.	Yellow Springs Gap. Back-bone vein,	.775	.110	.115
11.	Yellow Springs Gap. Vein next N. of Central Ridge,	.747	.148	.105
12.	Rattling Run Gap, - - -	.761	.169	.070

No.	Locality.	Carbon.	Volatile matter.	Ash.
13.	Tioga, - - - - - -	.725	.175	.100
14.	Cumberland, Md., - - -	.754	.170	.076
15.	Black Spring Gap. Grey vein,	.860	.045	.095

A comparison between the coals of Cumberland, Md., Blossburg, Penn., Dauphin Co., Penn. and South Wales, shows a remarkable similarity of composition as respects volatile matter. The greatest difference, in fact, scarcely exceeds one half of one per cent, as will be seen by the following table.

	Carbon.	Volatile matter.	Ash.
Cumberland, - - - - - -	.754	.170	.076
Blossburg, or Tioga, - - -	.725	.175	.100
Dauphin, - - - - - -	.761	.169	.070
South Wales, Dowlais, (by Berthier,)	.795	.175	.030

Philadelphia, Dec. 1, 1840.

Art. XIII.—*Proceedings of Scientific Societies.*

I. *American Philosophical Society.*

Nov. 6, 1840.—Professor Bache submitted to the Society a Chart, representing the extraordinary variations of the magnetic declination during the term day, on the 29th of May last, prepared by W. C. Bond, Esq., from the observations at the Magnetic Observatory at Cambridge.

Professor Bache read an extract of a letter from Lieut. Riddell, director of the Magnetic Observatory at Toronto, U. C., which stated that an entire discordance had been found between the curve representing the changes of inclination, on the February magnetic term day, at Toronto, Dublin, Brussels, and Prague, whilst those at the last three named stations agreed very well together. This result, Professor B. stated, confirms the conclusions previously drawn from the observations at short intervals, of Prof. Lloyd and himself, in November last.

Mr. Walker made some observations in relation to the Observatory of the Harvard University, Cambridge, and stated that extensive arrangements had been made, and were in contemplation, for prosecuting magnetic observations and practical astronomy.

Professor Bache made a verbal communication of some recent determinations of the magnetic dip, made by him at Philadelphia and Baltimore.

He reminded the society, that on a former occasion he had submitted a comparison of the observations for magnetic dip at various stations, common to the series of Prof. Loomis, (Am. Philos. Soc. Trans Vol. VII,

N. S.,) and to that of Prof. Courtenay and himself. The discrepancies at Philadelphia and Baltimore were among the most striking. Having satisfied himself that the dip given by his instrument at the station occupied by Prof. Loomis, near Philadelphia, was sensibly the same as that given by Prof. Loomis, his next step was to ascertain, by observations in a different position from those used in both the sets of observations formerly made, which probably represented more correctly the dip at Philadelphia. The result of two series of observations near the observatory at the Girard College, (at a sufficient distance to be beyond sensible influence from the magnetic instruments,) made with four different needles, was as follows:—

July 21, 1840. No. 1, 71° 51.7′. No. 2, 71° 51.7′. Mean of Lloyd, No. 1 and No. 3, 71° 55.8′.

November 2, 1840. No. 1, 71° 51.2′. No. 2, 71° 51.0′. Mean of Lloyd, No. 1 and No. 3, 71° 57.4′.

Mean, 71° 53.3′.

The needles, termed Lloyd No. 1 and No. 3, are used without reversing the poles; and a correction has been applied from the mean of sixteen comparisons, with the ordinary needles, at different places: as, however, this correction is obtained through Nos. 1 and 2, the results merely add to the number of observations from which the mean is obtained.

Prof. Bache remarked that his former result was thus confirmed.

At Baltimore, the place of observation was in the second square, N. E. of the Washington Monument. The same needles were used.

Aug. 27, 1840. No. 1, 71° 31.7′. No. 2, 71° 39.1′. Mean of Lloyd, No. 1 and No. 3, 71° 32.4′. Mean, 71° 34.4′, differing from the results of both the former series.

Prof. Bache stated, in continuation, that the geological formations at and near Baltimore, rendered it difficult to select an unexceptionable site for magnetic observations there, and was a sufficient explanation of the observed discrepancies. The results, which he had at present obtained, differed about 10′ from the mean of those of Professors Courtenay and Loomis.

Dr. Patterson announced the death of Prof. Charles Bonnycastle, a member of this society, (elected at the last meeting,) which took place on the 31st of October.

Nov. 20.—Dr. Patterson, from the observatory committee, reported, that an ordinance had passed the city councils, authorizing the erection of an astronomical observatory within Rittenhouse square. It was subsequently resolved, that the terms of the ordinance be accepted by the society, and that the observatory committee be instructed to take the necessary measures under the powers given them, for carrying into effect the objects of the ordinance.

Prof. Bache stated, that along with Messrs. Walker, Kendall, Cresson, Frazer, and a pupil of the High School, he had watched for meteors or shooting stars, at the High School, on the nights of Nov. 12–13, and 13–14, and met with the usual negative results of the observations before made in Philadelphia.

Dr. Horner called attention to the noise and shock observed about 9 o'clock on Saturday evening last, (Nov. 14,) which were supposed by some to be those of an earthquake. Judge Hopkinson referred to a statement, that the phenomena were supposed to be produced by the explosion of a near meteor. Mr. Nicklin mentioned facts, which induced him to think there had been a slight shock of an earthquake at the time mentioned. Dr. Chapman and Mr. Cresson attributed the rumbling noise and shock to thunder. Dr. Chapman had noticed a flash of lightning near the horizon, which was followed by thunder. Mr. Cresson had noted an interval of nearly two minutes between the flash of lightning and the clap of thunder.

Prof. Henry described an apparatus for producing a reciprocating motion by the repulsion in the consecutive parts of a conductor, through which a galvanic current is passing; and made some remarks in reference to the electro-magnetic machine invented by him in 1829, and subsequently described by Dr. Ritchie, of London. The machine referred to had been applied recently by Prof. Henry in his experiments.

Prof. Bache communicated an extract of a letter from Prof. Rümker, director of the observatory of Hamburg, which contained the results of his observations of Galle's first comet, and occultations observed in April, May, June, and August, 1840.

Dec. 4.—The committee, consisting of Mr. Richards, Dr. Ludlow, and Mr. G. M. Wharton, on a communication of Prof. Forshey, of Natchez, containing a description of the great mound near Washington, Adams county, Mississippi, reported favorably of the same, and expressed the hope, that the author might be enabled to prosecute farther examinations, "the result of which, with his enlightened commentaries, would furnish a most acceptable addition to the Transactions of the Society."

The mound, described by Professor Forshey, is found about nine miles north-east from the city of Natchez, Mississippi, upon the most elevated portion of that comparatively low and level region. It is approached on all sides by a slope. The elevation of its base above the mean level of the waters of the Mississippi, at Natchez, is estimated at 265 feet, and the greatest height of the mound above the earth, 84 feet. The whole elevation above the waters of the river 348 feet, giving to the spectator a clear horizon of 150 degrees, embracing, in that flat region, a rich and extended prospect.

The mound is an irregular artificial elevation of earth, varying, in its general line, from 40 to 46 feet in height, and encloses an area of about seven acres inclusive of the ground covered by its base. On the surface of the general mound are erected, at irregular intervals, 15 smaller mounds, one of which is 38 feet in height, and the remaining 14 varying from 4 to 12 feet in height. The mound consists of clay, with some admixture of earth, and its sides seem to have been faced with rudely formed brick, made from the adjacent clay. The bricks are found after digging to the depth of some 12 or 15 inches into the embankment. The western front is ascended by two causeways, which are distinctly marked, and are found one at each angle of the mound. At the eastern extremity is another causeway entrance to the enclosure, and near to this entrance, and outside the embankment, may be traced, for some distance, an ancient fosse. The three causeways are of easy ascent, and wide enough for the introduction of burthens. Upon the north and south sides of the great mound, and at points nearly opposite to each other, covered entrances or archways were constructed, but they are now so obstructed as to be difficult of examination. Before the forest was cleared by civilized culture, tradition relates that extensive avenues reached north, south, east, and west, thus affording, from the elevation of the great mound, a most attractive prospect.

The result, of the partial examinations made, shows that portions of the mound were used as places of interment by the Indians. The cranium secured by Prof. Forshey was of the tribe of Flatheads.

Earthen vessels of rude construction, and probably used frequently as receptacles for the remains of those interred, or as mementos at their funeral obsequies, are found. Various objects from the mound have reached the Lyceum at Natchez.

The committee, consisting of Mr. Lea, Dr. Hays, and Mr. Ord, to whom was referred a communication, entitled "remarks on the dental system of the mastodon, with an account of some lower jaws in Mr. Koch's collection, St. Louis, Missouri, where there is a solitary tusk on the right side, by William E. Horner, M. D., professor of anatomy in the University of Pennsylvania," reported in favor of the publication, which was directed accordingly.

Dr. Horner inquires into the mode of formation of the teeth of the mastodon, and compares it with that of the elephant and of man. The teeth of the mastodon are all formed upon one type of configuration, the number of denticules excepted; they therefore, like those of the elephant, do not admit of a division into incisors, cuspidati, and molares, as in some other animals. The teeth are all molars. The lower jaw itself resembles somewhat a human lower jaw cut off in front of the molar teeth, and then joined in the two posterior segments. These teeth invariably succeed each other from behind; the hindmost, as they emerge, pushing the others forward, and out of their places, until the latter all drop out, and a large solitary tooth is finally left on each side of each jaw.

Dr. Horner alludes to the erroneous nature of the early ideas of naturalists on the teeth of the mastodon, and observes that we now know, with some degree of certainty, that the earliest teeth of this animal were not more than an inch and a half square, and that the three immediately succeeding were a gradual and successive enlargement on this and on each other's volume. In the museum of Mr. Koch, at St. Louis, there is a young head, the long diameter of which is 18 or 20 inches, where the fact of four co-existent teeth on each side of each jaw is exhibited. This specimen, with a dozen lower jaws of different ages and sizes, enables us to trace, with some accuracy, the stages of dentition, until it reaches the large and solitary grinder of ten inches in length on each side. Judging from these phases of dentition, Dr. Horner infers that the entire amount of teeth was at least 24; he is disposed, indeed, to think that the number may have been greater than this; perhaps 28, and possibly 32.

Dr. Horner makes some observations on some specimens of lower jaws in Mr. Koch's museum in St. Louis, in which there was a solitary tusk on the right side, and alludes to the embarrassments that their existence occasions in regard to the Tetracaulodon of Godman; whether, for example, we are to consider them merely as abnormous types of that animal, as known mastodons, or as still another species to which, if such, the name Tetracaulodon might be attached. Dr. Horner confesses himself unable to suggest a probable solution of these questions, and states, in connection with them, that Mr. Koch has the lower part of the head of a mastodon of middling size, in which, from the intermaxillary bone, as usual, protrudes a tusk, which measures thirty inches long by four inches in diameter; but the tusk exists only on the left side, there being not even a vestige of alveolus on the right.

It is very far from being certain, Dr. Horner adds, that any example exists of the upper jaw of the Tetracaulodon; the presence of tusks in both jaws at once has therefore to be yet proved.

The committee consisting of Prof. Bache, Dr. Patterson, and Mr. Lukens, to whom was referred the paper, entitled "observations to determine the magnetic intensity at several places in the United States, with some additional observations of the magnetic dip, by Elias Loomis, professor of mathematics and natural philosophy in Western Reserve College," recommended the same for publication in the Society's Transactions, which was ordered accordingly.

The following is an abstract of the results of observations contained in this memoir.

1. *Magnetic Intensity.*—The horizontal intensity was observed by an apparatus similar to the one used by Prof. Hansteen. Three small needles furnished to the author by Prof. Renwick, and made under the direction, respectively, of Professor Hansteen, Major Sabine, and Prof. Henry, were employed. The commencing semi-arc of vibration was, in every

case, 30°, and each series included 320 oscillations, the instant of the completion of every tenth vibration being noted. No correction, therefore, is applied for the arc of vibration. The times were observed at Dorchester, Princeton, and Philadelphia, by a chronometer, and at the other stations by a lever watch, which, at Hudson, was compared with the observatory clock before and after the observations. The author remarks, that "at the remaining stations there is a little uncertainty with regard to the time, yet it is thought its influence upon the results will not be great."

The correction for temperature, for each of the needles, was obtained by direct experiment, and gave the following coefficients:—

For the Hansteen needle, .000191; for the Sabine needle, .000328; for the Henry needle, .000116. The results of observation are reduced to a standard temperature of 60° Fah.

The author gives the reasons which induce him to apply no correction for the change of magnetism in the needles. The observations for horizontal intensity were principally made in September and November, 1839.

The stations of observation at different places were the same as formerly described, (Am. Phil. Soc. Trans.) except at Dorchester, which was near Mr. Bond's observatory. The details of the observations are given, and from the mean of those for horizontal intensity, combined with the dips formerly observed, the author gives the total intensities, taking New York as 1.803, according to the determination of Major Sabine, and referring to the unit established by Humboldt, as follows:—

	Horizontal Intensity.	Dip.	Total Intensity.
New York,	.96707	72° 52.2′	1.803
New Haven,	.92364	73 26.7	1.780
Dorchester,	.88182	74 16.0	1.786
Providence,	.89830	73 59.6	1.789
Princeton,	.97414	72 47.1	1.807
Philadelphia,	1.00000	72 07.0	1.788
Hudson,	.97344	72 47.6	1.807

The author remarks that Hudson, Ohio, and New York, thus appear to have sensibly the same magnetic dip and intensity. He concludes this part of his memoir with a comparison of his intensity observations with those of Professors Bache and Courtenay.

2. *Magnetic Dip.*—This section commences with an account of observations of the magnetic dip, made at Hudson, Ohio, in different azimuths, to try the figure of the axles of the dipping needles. The results for needle No. 1 were quite satisfactory, and for needle No. 2, showed a difference in the extremes of 12.7′: upon a review of the whole, the author considers them as justifying confidence in the needles used.

The following determinations of the dip are next given:—

		Latitude.		Longitude.		Date.		Magnetic Dip.	
Hudson,	Ohio,	41°	15′ N.	81°	26′ W.	April 15,	1840,	72°	53.2′
Aurora,	"	41	20	81	20	Sept. 8,	"	72	55.5
Windham,	"	41	15	81	03	" 8,	"	73	03.4
Bazetta,	"	41	20	80	45	" 9,	"	72	59.7
Kinsman,	"	41	30	80	34	" 10,	"	73	08.1
Hartford,	"	41	19	80	34	" 10,	"	72	59.8
Warren,	"	41	16	80	49	" 11,	"	73	00.7
Cleveland,	"	41	30	81	42	" 22,	"	73	12.0
Bedford,	"	41	24	81	32	" 23,	"	72	58.0
Twinsburgh,	"	41	20	81	26	" 23,	"	72	51.3
Tallmadge,	"	41	06	81	26	" 28,	"	72	50.1
Shalersville,	"	41	15	81	13	Oct. 15,	"	72	56.6
Streetsboro',	"	41	15	81	20	" 16,	"	72	53.0
Tallmadge,	"	41	06	81	26	" 31,	"	72	48.2

Mr. Walker read a communication, entitled "researches concerning the periodical meteors of August and November, by Sears C. Walker," which was referred to a committee.

Prof. Bache brought before the society an instrument for measuring the changes in the vertical components of the force of terrestrial magnetism, which he described as combining the principles of the vertical force instrument of Prof. Lloyd, with that of reflection adopted in the magnetometers of Prof. Gauss, and which had been made for him by Mr. Saxton.

Prof. Bache stated, that having found difficulties in the use, especially by his assistants, of the vertical force instrument invented by Prof. Lloyd, and made for the magnetic observatory at the Girard College, by Robinson, of London, he had applied, in June last, to Mr. Saxton, to construct the instrument now presented to the notice of the society. The details had been matured by conference with Mr. Saxton. The magnetic bar, placed and supported as in the instrument of Prof. Lloyd, carries a mirror upon its axis. The mode of adjusting the position of the centre of gravity of the needle does not differ materially from that adopted in the instrument referred to. The needle is raised off the agate planes by the action of a screw, raising a bar which supports two small cups adapted to receive two projecting pins on the arms of the magnet. This magnetometer is observed from a distance, like those of Prof. Gauss. Prof. Bache explained the mode of adjusting the instrument, and of placing the scale and telescopes.

Prof. Bache called the attention of the society to a diagram representing the changes of magnetic declination, as recorded at the magnetic observatory of Mr. Bond, at Cambridge, and at the Girard College, on the magnetic term day of May, 1840, and showing that the changes attending the aurora are not peculiar to one locality, but that, as observed at different places, they are parts of a great magnetic disturbance.

The two curves thus presented agreed remarkably in all their general features, showing, as a general result, similar motions of the needle at the two places in direction, though not always proportional in amount. They presented remarkable differences in the absolute times at which these movements had taken place at the two stations, the similar movements differing frequently five minutes, (with opposite signs,) and in a few cases as much as ten minutes in time; in other cases being simultaneous. The period at which the needle had attained, suddenly, its greatest deviation from the true meridian, was ten minutes earlier in absolute time at Cambridge, than at Philadelphia.

Dr. Demmé referred to the contents of a circular letter from Germany, in which it was stated, that a number of gentlemen of Stuttgart had united, under the name "Societas Bibliophilorum Stuttgartiæ," to publish historical and antiquarian works, which are either out of print, or have never been printed.

The society at Stuttgart will begin to publish as soon as they have procured five hundred subscribers. The subscription is one pound sterling, for which the subscriber will receive one copy; and no more copies will be printed than are subscribed for.

Dec. 18.—The committee, consisting of Dr. Patterson, Prof. Bache, and Mr. Lukens, to whom was referred the communication of Prof. Henry, entitled "Contributions to electricity, No. IV., on electro-dynamic induction," reported in favor of publication, which was directed accordingly.*

The committee, consisting of Mr. Nuttall, Mr. Lea, and Dr. Coates, to whom was referred a communication by Miss Margaretta H. Morris, on the Cecidomyia Destructor or Hessian Fly, reported in favor of publication, which was ordered accordingly.

The committee express the opinion, that should the observations of Miss Morris be ultimately proved correct, they will eventuate in considerable benefit to the agricultural community, and, through it, to the public. Miss Morris believes she has established, that the ovum of this destructive insect is deposited by the parent in the seed of the wheat, and not, as previously supposed, in the stalk or culm. She has watched the progress of the animal since June, 1836, and has satisfied herself that she has frequently seen the larva within the seed. She has also detected the larva, at various stages of its progress, from the seed to between the body of the stalk and the sheath of the leaves. In the latter situation it passes into the pupa or "flaxseed state." According to the observations of Miss Morris, the recently hatched larva penetrates to the centre of the straw, where it may be found of a pale greenish-white semi-transparent appearance, in form somewhat resembling a silk-worm. From one to six of these have

* We omit the abstract of this paper, as it will appear in full in this Journal.

been found at various heights from the seed to the third joint: they would seem to enter the pupa state about the beginning of June.

This fly was not observed by Miss Morris to inhabit any other plant than wheat.

To prevent the ravages of this destroyer of the grain, it will be proper to obtain fresh seed from localities in which the fly has not made its appearance. By this means the crop of the following year will be uninjured; but in order to avoid the introduction of straggling insects of the kind from adjacent fields, it is requisite that a whole neighborhood should persevere in this precaution for two or more years in succession. This result was obtained, in part, in the course of trials made by Mr. Kirk, of Bucks county, Pa., with some seed-wheat from the Mediterranean, in and since the year 1837. His first crop was free from the fly, but it was gradually introduced from adjacent fields; and in the present year the mischief has been considerable. As Miss Morris states that the fly has never made its appearance in Susquehanna and Bradford counties, seed-wheat, free from the fly, might be obtained from these, and probably from other localities.

The committee recommend that the conclusion of Miss Morris "may be subjected to the only efficient test—repeated observations and effective trials of the precaution she advises."

The committee, consisting of Prof. Rogers, Dr. Bache, and Mr. Booth, on a communication, entitled, "on the perchlorate of ethule or perchloric ether, by Clark Hare and Martin H. Boyé," reported in favor of publication, which was ordered accordingly.

In the above paper, the mode of obtaining the perchloric ether, by subjecting a mixture of sulphovinate of baryta and perchlorate of baryta to distillation, is first described. The authors next detail the precautions to be attended to in preparing and experimenting upon this highly explosive compound. They afterwards describe the appearance and properties of the substance which ranks in that class of organic salts, denominated *ethers*. It is a colorless, transparent liquid, heavier than water, and soluble in alcohol, from which it may be precipitated again, by the addition of water. An alcoholic solution of the hydrate of potassa has the power of decomposing it, forming perchlorate of potassa and alcohol. The most characteristic property of the compound is its tendency to explode from the slightest causes.

Dr. Patterson called the attention of the society to the subject of the evolution of electricity from steam, mentioned at the last meeting, and stated that the experiments made lately in England had been successfully repeated by Mr. Peale, Mr. Saxton, and himself, at the United States' mint.

Dr. Patterson said, that their first attempts were to collect electricity from the steam as it issued from a gauge-cock, near the surface of the water, in the boiler; but in this case the steam was always accompanied by a spray of water, and the experiments failed. They also failed when the steam was of a low temperature, as it was then condensed immediately upon leaving the boiler, so as to form a cloud of vesicular vapor. In both these cases, the electricity, if evolved at all, would be led back to the boiler—the spray and the vesicular vapor being, as is well known, electrical conductors.

When, on the other hand, high steam was drawn off from a stop-cock far removed from the water in the boiler, it was observed to issue, for some distance, in the form of a transparent gaseous vapor, and, in this case, any insulated body on which it was condensed was always found to be charged with electricity. Thus, if the experimenter stood on an insulating stool, or even on a box or ladder of dry wood, and held an iron ladle, or any other conductor, in the issuing steam, the conductor and the operator became so fully charged with electricity, that thick sparks of a half, three-quarters, and in some instances a whole inch in length, were drawn off; the Leyden jar charged; the shock given to several persons holding hands, &c. The electricity thus produced was found to be always positive.

Dr. P. said, that one of the most important conclusions to which the experiments had led, was, that true gaseous steam is a non-conductor of electricity. If it had not been so, the apparatus would not have been insulated, and the electricity excited would have been carried back to the metallic boiler, and thence to the earth.

Dr. P. thought it most probable that the electricity, in these experiments, was evolved by the condensation of the steam—the phenomenon being analogous to the evolution of latent heat by the same condensation. He remarked, that as the steam within the boiler was surrounded by conductors, it could not be supposed to contain free electricity, and that on leaving the boiler, the only sources to which the electricity could be ascribed, seemed to be the condensation of the steam, the oxidation of the iron against which it impinges, or the friction of the steam against the air as it rushes through it.

To show that oxidation was not the source of the electricity, the experimenters caused the steam to strike upon a large bar of fine gold, (400 oz. in weight,) and the generation of electricity was as abundant as when they employed an oxidizable metal. The electricity was also evolved by the insulated operator simply holding his hand in the steam as it issued; in which case the steam was condensed upon the hand, and the whole person became charged. Dr. P. stated, that this was, in fact, the experiment accidentally made near New Castle, in England, and which has attracted so much attention.

To show that the electricity was not caused by the rushing of the vapor through the air, Dr. P. said that an apparatus was made, consisting of a pipe connected with the stop-cock on the boiler, a portion of about ten inches in length, near the upper end, being of glass, to produce insulation, and the remainder of lead, wound into a helix, like the worm of a still. This helix was immersed in a bucket of water and snow. When the steam was admitted, it became entirely condensed within the pipe, so that there was no rush through the air; yet the production of electricity was as abundant as with the former arrangements.

Dr. P. took notice of experiments made, half a century ago, by Volta and Saussure, and afterwards by Cavallo, which proved, to their satisfaction, that electricity was evolved during evaporation and condensation, but which have since been called in question by Pouillet and others, who assert that a mere change of state, not accompanied by chemical change, never gives rise to electricity. He considered the experiments, now made on a large scale, as favoring, if not confirming, the first opinions entertained on this subject.

Dr. P. referred to the satisfactory manner in which these new experiments seem to explain the sources of electricity in the thunder storm, and in volcanic eruptions.

He then related an experiment in which an insulated iron ball, and afterwards a bar of gold, was heated, and a small stream of water poured on it, so as to be formed into steam at its surface. The first experiments seemed to show that the metal was charged with negative electricity, but subsequent trials threw doubts upon this conclusion.

Dr. P. also described experiments made to determine whether electricity was given off during the solidification of liquids,—the substances used being melted lead, silver, and gold. In every case, however, the gold-leaf electroscope failed to exhibit the presence of any electricity.

Prof. Henry stated that he had not seen the sparks from steam; but that he had obtained feeble electricity from a small ball, partly filled with water, and heated by a lamp. He agreed with Dr. Patterson in the opinion, that the source of the electricity was the change of state, but from water to vapor. There was, however, some doubt on the subject; Pouillet had denied the evolution of electricity from the evaporation of pure water. The facts were interesting, particularly on account of the great intensity of the electricity. The results, obtained by the philosophers, which had been mentioned, indicated electricity of very feeble tension, which could only be observed by the most delicate instruments, but here the sparks were an inch in length. If the vaporization of the water were shown to be the source of the electricity, Prof. Henry thought that the phenomena might be readily explained by the beautiful theory of Becquerel, in regard to the production of the great intensity of the electricity in the thunder cloud. According to this theory, each particle of the vapor carries up with it into the atmosphere the free electricity, which it receives at the moment of the change of state: this, being diffused through the whole capacity of the air, is of very feeble intensity, although of great quantity; but the condensation of the vapor into a cloud affords a continuous conductor, and consequently the electricity of all the particles of the interior, according to the well known principles of distribution, rushes to the surface of the cloud, and hence the great intensity of the lightning. According to this hypothesis, the insulated conductor, placed in the steam, would act not only as a collector, but also as a condenser of the free, but feeble electricity of the vapor.

Prof. Henry farther stated, in connection with this subject, that he had been informed by several persons, that they had obtained sparks of electricity from a coal stove during the combustion of anthracite. A case had been stated to him several years ago, which he mentioned to his friend, Professor Bache, who informed him that a similar one had fallen under his own notice, in which, however, Prof. Bache had succeeded in tracing the electricity to the silk shirt of the person who drew the spark. Another case had lately been reported to him by an intelligent gentleman, of a stove burning bituminous coal, on board of a steamboat on the Ohio, which afforded amusement to all the passengers during the voyage, by giving sparks of electricity whenever it was touched.

In connection with the facts that had been stated of the production of electricity from steam, Prof. Henry observed that he was now inclined to believe that electricity may also be evolved during the combustion of coal in a stove. But what, he asked, is the source of electricity in this case? Is it combustion, the evaporation of the moisture, or the friction of the hot air on the interior of the pipe?

Dr. Goddard stated, that in the case of a stove, pretty well insulated, his family had amused themselves with drawing sparks half an inch or three quarters of an inch long; and that similar sparks were obtained from the frame of a looking-glass over an open grate, in the house of Dr. Norris, of this city.

Professor Bache remarked, that in the case referred to by Prof. Henry, in which sparks of electricity were obtained from a stove, he had satisfied himself that these were owing to the experimenter wearing a silken shirt:—an experimenter, not similarly clad, being unsuccessful.

Dr. Hare ascribed the incredulity and the opinions which he had expressed, when this subject was brought before the society by Mr. Peale, at the last meeting, to a misapprehension, on his part, as to the circumstances. He considered that the fact of electricity being developed in the case adduced, was established. He alluded to the almost incredible case of a lady, who, agreeably to evidence mentioned in Silliman's Journal, Vol. XXXIII, gave off sparks of electricity. He stated also the result of an experiment to discover whether electricity was given off during the rapid evaporation of a saline solution. There was no evidence of excitement. The vessel was of glass.

Mr. Lea had frequently observed sparks from a common grate.

In reference to the results of experiments by Dr. Patterson, in which no evidence of the development of electricity was observed in metals, whilst undergoing a change from the liquid to the solid state, Dr. Goddard observed, that in cases of crystallization on the large scale, as of nitre, in the extensive chemical works of Mr. Wetherill, a beautiful flash of electrical light was apparent.

Professor Rogers suggested, that in ordinary combustion there may be a constant development of electricity, and that means may possibly be found to render it apparent by perfect insulation.

Professor Henry stated that Pouillet had found that electricity is developed by the combustion of charcoal, and he offered some suggestions as to the mode of rendering the electricity, given off from a stove, apparent, by insulating it both above and below.

Dr. Emerson thought that the change of state from solid to liquid, and from liquid to solid, might account for various electrical phenomena presented by the animal body. Dr. Hare suggested the difficulty, that the human body is a good conductor; and that without a peculiar organization, analogous to that with which nature has endowed the Torpedo or Gymnotus, it is inconceivable that electrical discharges could arise from vital organization. He believed it was admitted by electricians, that there could be no electrical excitement without the existence of the opposite electricities. Agreeably to the published facts of the case to which he had alluded, the lady was permanently in one state of excitement, generating electricity, as animal heat is generated, and throwing off the excess in sparks.

In the case of the Gymnotus, the intensity, Dr. Hare remarked, is so low that sparks are with difficulty rendered apparent at a kerf made by a knife in tinfoil; of course the sparks alleged to be given by the lady, were vastly more intense. From the Gymnotus, sparks could only be received by forming a circuit with a portion of the organic series situate parallel to the spine. Contact in a transverse direction was not productive of any discharge.

II. *Proceedings of the Boston Society of Natural History. Compiled from the records of the society.*

May 20, 1840.—J. E. Teschemacher, Esq., in the chair.

Dr. Enoch Hale read a letter from Rev. Thomas S. Savage, M. D., a missionary at Cape Palmas, West Africa, accompanying which was a valuable donation of entomological and other specimens. The following is the portion of the letter relating to the specimens.

Mt. Vaughan, near Cape Palmas, West Africa, Jan. 15th, 1840.

Dear Sir.—I send five specimens of the *Calandra palmarum* or palm weavel. This insect inhabits the *Elais Guineënsis*, the palm tree from which the natives obtain their palm oil. It lives upon the juices of the tree, which, as they exist in their natural state, are exceedingly sweet and pleasant. It penetrates the cabbage by its rostrum, and is thus often found in the act of sucking the natural palm wine. I am informed by the Africans that the male is distinguished from the female, by being of a smaller size; the female is provided with a tuft of yellow hair upon the upper edge of the beak and the tibia of the fore leg. The larvæ and the fully developed insect are eaten by the natives, and in either state are considered a delicacy; they are eaten uncooked or roasted, with pepper and salt. They are taken by the aged and impotent for their supposed aphrodisiac powers.

There is also a smaller species of *Calandra*, which is very destructive to the rice; it is probably the *C. granaria* of Europe.

The best and rarest of the Lamellicornes which I have transmitted to you, are three specimens of the *Scarabæus Goliathus* of Lin. and Drury. This species has received the different generic names of *Cetonia*, Fab. and Olivier, *Goliathus*, Lamarck and Duncan, and more recently *Hegemon* from Dr. T. W. Harris, of Harvard University. The larger specimen seems to be the *Cetonia cacicus*, Fab. and Oliv., first described by Voët in 1785, and erroneously supposed to be a native of America. (See Hope's Coleopterist's Manual.) This is positively pronounced by the natives to be a male, of which there can be no doubt, from what is known of the sexual distinctions among the group of Lamellicornes. The two smaller specimens are undoubtedly the females of the larger specimen; they are evidently identical with the insect described by Hope as *C. princeps*, and which on dissection proved to be a female; and uncertain whether it had been previously described, he gave it the above name provisionally. The natives declare very positively that it is the "woman" of the larger specimen. They are both found on the same tree and have the same habits. They are not found immediately on the coast, but some miles back from the sea. They abound in January, February and March, and are easily obtained when the natives cut the forest trees preparatory to planting their rice. Yours, &c. Thos. S. Savage.

Dr. T. W. Harris stated that he regarded the specimen described by Dr. Savage as the *Goliathus*, the most valuable addition which had ever been made to the entomological cabinet; he thought it distinct from the *cacicus*, the latter wanting the spots on the shoulders which existed in the specimen under consideration. He regarded it as an undescribed species.

Dr. J. Wyman, exhibited the cranium and drum of the howling monkey, *Simia seniculus*, Buff., a donation to the cabinet from F. W. Cragin, M. D. of Surinam. The cranium is remarkable for the great obliquity of the face, the facial angle being only 30°. When placed in its natural position, the occipital hole is found to be on a level with the superior part of the orbit, and instead of being situated in the plane of the base of the skull as in most of the other quadrumana, it forms a right angle with it as in the rodentia. The lower jaw is excessively developed both in its body and branches, having a surface almost equal to that of the cranium. The branches of the lower jaw form two walls of a large cavity, in which is contained the body of the hyoid bone, modified in a most remarkable manner. The body or central portion of the hyoid bone is transformed into a bony box of an ovoidal shape, the parietes being very thin and elastic. Posteriorly this box is provided with a large opening of a quadrangular shape; on each side of this orifice are two articulating surfaces for the cornua of the hyoid bone. The following are the dimensions of the box, antero-posterior diameter, $2\frac{3}{4}$ inches; vertical, $2\frac{1}{2}$ inches; transverse, $2\frac{1}{4}$.

According to the dissections of Cuvier, the right ventricle of the larynx communicates freely with the cavity of the bone; the left ventricle terminating at the bone without entering it, so that the vocal organs were not symmetrical, presenting a remarkable exception to the characters of the organs of animal life. It is to this remarkable modification of the organs of voice, that the howlers are indebted for the power which they possess of making those loud, hoarse and disagreeable sounds which are capable of being heard at the distance of half a league. They are in the habit of congregating in trees at sunrise and sunset or at the approach of a storm, and of uttering prolonged and frightful howls.

July 15th, 1840.—C. K. Dillaway, Esq., in the chair.

Dr. D. H. Storer read descriptions of eleven species of fishes from the western rivers, by Dr. J. P. Kirtland, of Ohio, each description being accompanied by an accurate drawing. The names of the species were as follows; *Ammocetes concolor*, Raf.; *Coregonus albus*, Les.; *Esox reticulatus*, Les.; *Esox estor*, Les.; *Rostra edentata*, Raf.; *Notuus flavus*, Raf.; *Rutilus Storeri*, Kirt.; *Pimelodus nebulosus*, Les.; *Salmo namycush*, Pen.; *Pimephalis promelas*, Raf.; *Labrax* ——.

An elaborate review of Richard's work on the Coniferæ, was read by Geo. B. Emerson, Esq., president of the society.

Dr. J. Wyman, exhibited specimens of wood, pine cones, and acorns, taken from an excavation in Lowell, near the junction of the Concord and Merrimack rivers. They were found buried in sand at the depth of about 25 feet, several feet below the level of the surface of these rivers. Large trunks of pine trees were found in the same locality, also large quantities of leaves arranged in layers or strata. One of the most interesting objects met with in this locality, was the epidermis from the shell of a Unio, this preserving its shape entire, although the shells had disappeared. These cuticular coverings were found in great numbers; but in no instance was the shell found in connection with the epidermis, this portion having probably been decomposed.

J. E. Teschemacher, Esq., made a report on some seeds and plants from New Zealand, which had been forwarded to Thos. A. Greene, Esq. of New Bedford; these plants and seeds were referrible to the following genera, *Ipogon*, *Mongleria*, *Petrophila*, *Leptospermum*, *Melaleuca*, *Verticordia*, *Acacia* and *Trichinium*. The flora of New Zealand is not yet generally known in Europe by botanical description. Dr. Endlicher has given an excellent description of some of the plants, and Baron Hugel, Robt. Brown, Lindley, and Hooker, of others; many species however remain undescribed.

Aug. 19th, 1840.—Geo. B. Emerson, Esq., President, in the chair.

Dr. D. H. Storer reported on the reptiles presented to the cabinet by Dr. Savage of Western Africa. This collection consisted of thirteen specimens, each a distinct species, and only one of which was previously in the cabinet; they were all referrible to the genera *Monitor*, *Agama*, and *Scincus*, among the Saurians; *Acontias*, *Crotalus*, *Naia* and *Coluber*, among the Ophidians; there was but one Batrachian and that belonging to the genus *Hyla*. Three species of fish accompanied the collection, belonging to the genera *Psettus*, *Julis* and *Scarus*.

Dr. F. A. Eddy exhibited a specimen of the plant known by the name of "slink weed," which is supposed to have the property of inducing abortion. He stated that a meadow in which this plant was common had gone into disuse, from the fact that the cows habitually cast their calves after feeding upon the herbage: this effect was attributed to the presence of this plant. He believed it to be identical with *Lythrum verticillatum*, L.

Dec. 16th, 1840.—Thomas Bulfinch, Esq., in the chair.

Mr. J. E. Teschemacher made a verbal report on some botanical specimens from Arkansas and other western states, presented to the society by Mr. Edward Tuckerman, Jr. He showed that the *Ergrinum Arkansanum* agreed in its botanical characters with *E. Perofskianum* from Erboul, excepting that the leaves in one are more uncinate than in the other. Mr. T. exhibited dried specimens of the leaves of the *Nepenthes distillatoria*, or pitcher plant; this is a diœcious plant, allied to the *Sarracenia* of this country. The cups formed by the leaves are constantly filled with water secreted by glands on their inner surface; also the fruit of the *Calamus rudentum* or rattan. This is one of the Palmaceæ, its fruit a catkin, spathes numerous; ovarium 3 celled; berry one seeded.

Dr. D. H. Storer exhibited a specimen of the *Polyodon foliaceus*, Lacep. This is characterized by the form of the rostrum, which is long and flat, extending some distance beyond the head, which is commonly known by the name of "fadole," the use of which is not well ascertained. It is however seen thrusting it into the mud in obtaining its food.

Dr. A. A. Gould laid on the table the following species of shells from the Altamaha river, in Georgia, presented to the Society by Jas. Hamilton Couper:—*Unio spinosus; U. Shepardianus; U. obesus; U. splendidus; U. Hopetonensis; U. dolabriformis; U. lugubris;*—also the *Anodonta gibbosa* of Say.

Jan. 20th, 1841.—Geo. B. Emerson, Esq., President, in the chair.

The President exhibited the seed vessel of the *Nelumbium luteum* from the Missouri river. The *N. luteum* belongs to the natural order of the Nymphyæaceæ of De Candolle, of which the number of species is small. It is mentioned by Pursh as occurring in ponds in the neighborhood of Philadelphia, where from its isolated situation, he supposed it must have been carried by the Indians. It is mentioned by Prof. Hitchcock as occurring in Haddam, Conn. The seed vessel is of a conical shape, the base being perforated by about twenty orifices opening into as many cells, each containing a single seed resembling an acorn in shape. This is well figured by Bauhin, and is designated by him as the *Faber Egyptiaca.* The *N. luteum* is described by Mr. Nuttall as bearing the largest of American flowers, the magnolia excepted. Dr. F. A. Eddy states that from descriptions given him by others, he had no doubt that this plant existed in Smithfield, R. I.

Dr. J. Wyman exhibited the cranium of the *Stenorhynchus leptonyx* of Blainville, recently presented to the society's cabinet by Dr. J. B. Johnson of New Bedford. This species is well distinguished from all the other Phocidæ, by the remarkable form of its molar teeth, all of them having the crown deeply trifid, so as to form three sharp conical points, the two exterior of which are bent towards the median line, and the central and longest one having its point curved backwards. The cranium of this species was first figured by Sir Everard Home in his Comparative Anatomy, and in the Philos. Transactions, for 1822. It was afterwards more accurately described by Blainville, by whom it received the specific name of *leptonyx;* his description was drawn from another specimen in one of the French museums. The animal to which this cranium belongs is an inhabitant of the southern Pacific seas, and its habits are not known.

Mr. J. E. Teschemacher exhibited the following specimens of minerals lately received from Dr. Monticelli, some of which are entirely new in this country, viz. Gismondine in Thompsonite, regarded by Brooke and acknowledged by Monticelli as synonymous with Phillipsite and Arisite; Christianite which, according to the Berlin mineralogists is synonymous with Fosterite; Humite; Biotine in brilliant white crystals; Monticellite, of which there is no description; Häuyene in dodecahedral crystals; chloride of copper. Mr. Teschemacher had also been informed by Dr. Monticelli, that the sulphurets of zinc and lead had been met with in lava; it was difficult to account for the presence of these substances, inasmuch as they are volatilized by a temperature equal to that of melted lava.

Art. XIV.—*Bibliographical Notices.*

1. *Plantæ Javanicæ Rariores, descriptæ iconibusque illustratæ, quas in Insula Java, annis* 1802–1818, *legit et investigavit* Thomas Horsefield, M. D.: *e siccis descriptiones et characteres plurimarum elaboravit* Joannes I. Bennett; *observationes structuarum et affinitates præsertim respicientes passim adjecit* Robertus Brown. London, fol. Part I, 1838; pp. 104, tab. 1–25.—Part II, 1840; pp. 90, tab. 26–40. This work is filled with profound observations upon various points in systematic and structural botany, by Mr. Brown, and his worthy associate, Mr. Bennett, (the present secretary of the Linnæan society,) who has elaborated the greater portion of the work. In a note annexed to his revision of the *Cyrtandreæ,* which occupies a portion of the second part, Mr. Brown has contributed a series of condensed, but most important remarks upon the structure of the ovarium, placentæ, and stigmata; and has also expressed his dissent from a recent theory respecting the origin of ovula, (advocated by Schleiden, Endlicher, Lindley, &c.) viz. that the ovula do not belong to the transformed leaf or carpel itself, (except, perhaps, in a few cases,) but are borne on the axis, or on processes of the axis united with the carpels; a view which the analogy of ovula with buds would readily suggest. Mr. Brown defends the prevalent theory, in the following brief remarks. "That the placentæ and ovula really belong to the carpel alone, is at least manifest in all cases where stamina are changed into pistilla. To such monstrosities I have long since referred in my earliest observations on the type of the female organ in phenogamous plants, (in *Linn. Soc. Trans. vol.* 12, *p.* 89,) and since more particularly in my paper on *Rafflesia:* (*ibid, vol.* 13, *p.* 212,) the most remarkable instances alluded to in illustration of this point being *Sempervivum tectorum, Salix oleifolia,* and *Cochlearia armoracia;* in all of which every gradation between the perfect state of the anthera, and its transformation into a complete pistillum, is occasionally found." The third and concluding part of the work is said to be in progress.

2. *Hooker's Icones Plantarum:* Part VII. In former numbers of this Journal we have already directed the attention of American botanists to this excellent work, and mentioned the plan upon which it is conducted. The seventh part, containing 50 plates, (viz. tab. 301 to 350,) includes perhaps fewer North American species than usual. Among them, however, are figures of our three species of the singular genus *Cercocarpus;* and also of five Californian Compositæ, viz: *Actinolepis multicaulis,* DC., *Madaraglossa heterotricha,* DC., *Hartmannia? pungens,* Hook. & Arn., *Monolopia minor,* DC., and *M. major,* DC. Plate 323 represents a species of the genus *Garrya,* from the mountains of Jamaica! "The very remarkable genus to which this plant belongs,

was established by Dr. Lindley in 1834, on a new plant of North California, found by Mr. Douglas, but discovered many years previously by Mr. Menzies, in his voyage with Capt. Vancouver, and existing in several herbaria to which he liberally presented it. It was, therefore, a matter of great astonishment to me, to find the same genus in a plant of Jamaica, to which Dr. M'Fadyen directed my attention about four years ago, and which is here represented. Mexico, however, which may be reckoned an intermediate country, is now known, by the exertions of Mr. Hartweg, to produce three other species, which are described by Mr. Bentham in his excellent *Plantæ Hartwegianæ*. Mr. Skinner has lately sent me a species, in fruit only, from Guatemala." *Hook.*—A portion of the volume is devoted to some interesting plants from Van Dieman's Land, described and figured by Dr. Joseph D. Hooker, the naturalist of the British Scientific Expedition, commanded by Capt. James Ross, now in the Antarctic sea.

3. *The Linnæa;* edited by D. F. L. Von Schlechtendal. (Halle.) Contents of the 4th, 5th, and 6th numbers of the 13th volume; for 1839.

On *Waldsteinia trifolia;* by *Dr. Koch,* of Erlangen. (With a plate.)

On the fountain of Antritz, near Grätz, (Styria,) in relation to its vegetation; by *Prof. Unger,* of Grätz.

On *Saracha* and *Physalis;* by *Prof. Bernhardi.*

Annual Report on the Flora of Hercynia; by *E. Hampe.* (Aug. 1839.)

Remarks on the genus *Grubbia* of Endlicher; by *J. F. Klotzsch.*

Monstrosities in plants; collected by *Dr. Von Schlechtendal.*

Prodromus Monographiæ Lemnacearum, or Conspectus Generum atque Specierum; by *M. J. Schleiden.* [The Lemnaceæ, following De Candolle, are considered as a tribe of Aroideæ; and the genus Lemna is divided into four genera, viz. 1. *Wolffia,* of Horkel; 2. *Lemna,* (L. minor and L. trisulca;) 3. *Telmatophace,* (founded on L. gibba;) 4. *Spirodela,* (founded on L. polyrhiza.) There is a translation of this memoir, in the *Annals of Natural History,* for December, 1840.]

On two very remarkable instances of vegetable transformation; by Garden-inspector *Weinmann,* of Pawlowsk.

Enumeratio Artemesiarum quas nondum vidit, *W. de Besser.*

De Plantis Mexicanis a Schiede and Car. Ehrenbergio aliisque collectis, &c.; by *Dr. Von Schlechtendal.*

Explanation of the irregularity in Papilionaceous flowers; by *H. Walpers;* (with a plate.)

Animadversiones criticæ in Leguminosas Capenses; by *G. W. Walpers.*

Upon some peculiarities in the growth of arborescent dicotyledonous plants; by *Dr. Becks,* of Münster.

De Galphimiis Mexicanis annotationes; by *F. Th. Bartling.*

On *Pinus pumilio;* by *H. R. Gœppert.*

Remarks on the family *Piperaceæ;* by *Prof. Kunth.* [Apparently a monograph of the order, occupying the whole of the sixth or last number for 1839.]

The Linnæa: contents of parts 1–4, for 1840.

Scholium to Hampe's Prodromus Floræ Hercyniæ; by *Dr. Wallroth.*

De Plantis Mexicanis, &c., continued; by *Dr. Schlechtendal.*

Upon the genus *Tetradiclis;* by *Dr. Bunge;* (with a plate.)

Conferva Lehmanniana, a new species, described by *Dr. Lindenberg;* (with a plate.)

On the structure of the stems of *Isoëtes lacustris;* by *Prof. Mohl;* (with a plate.)

On the *Hausschwarm,* [a kind of Fungus;] by *Schwabe.*

Synopsis Desmidiearum hucusque cognitarum; by *I. Meneghini.*

On the proper place of several families of plants in the natural system. (Anonymous.)

Some new Diatomaceæ of the Eastern coast of Adriatic; by *Hyacinth, Ritter Von Lobarzewski;* (with 3 plates.)

On the movement of the fluid in *Closterium Lunula;* by the same; (with a plate.)

On a collection of plants from Bahia; by *Dr. Schlechtendal.*

Observationes Botanicæ; by the same.

Compositarum novarum decades, offert *Dr. G. Walpers.*

Annual Report on the Flora of Hercynia, &c.; by *E. Hampe.*

On the Carices of Thunberg's Flora Capensis; by *Dr. Schlechtendal.*

On a monstrosity of the leaves of *Trifolium repens;* by *Dr. G. Walpers.*

Observations on the variation of the Willows; by *E. Hampe;* with additions by the Editor.

Four new species of *Mammillaria;* by *C. Ehrenberg.*

There are also copious bibliographical and miscellaneous notices appended to each number.

4. *Wikström; Annual Reports to the Royal Swedish Academy of Science, on the Progress of Botany.* The latest volume we have received, is the Annual Report for the year 1837, presented to the Swedish Academy in March, 1838, and published (in the Swedish language,) at Stockholm, in 1839. It forms an octavo volume of 612 pages: it gives a well arranged account of all the botanical works published during the year 1837, so far as they were known to the editor. This work is translated into German, from year to year, with some additions, by Dr. Beilschmied of Breslau, to whom we are indebted for a German edition of the Report for 1821, 1822, and 1824, (Breslau, 1838, forming a volume of 230 pages;) that for 1831, (Breslau, 1834, 200 pages;) and that for 1835, (Breslau, 1838,) which forms a volume of about 420 pages, with copious indexes, &c.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Exploring Expedition.*—The annexed is the official account of the discoveries made by the exploring squadron in the antarctic regions.

United States Ship Vincennes, March 10, 1840.

Sir,—I have the honor to report that having completed our outfits and observations at Sydney, N. S. W., the exploring squadron under my command, composed of this ship, the Peacock, Porpoise, and Flying Fish, sailed in company on the 24th of December, with my instructions to proceed south as far as practicable, and cruise within the Antarctic Ocean. Copies of the instructions were forwarded to you with my despatch, No. 57.

We continued in company until the first of January, when we parted company with the Flying Fish, and with the Peacock, in a fog, on the third.

I then steered, with the Porpoise in company, for our first rendezvous, Macquain's Island, and from thence to Emerald Island, our second rendezvous, having passed over the supposed locality of the latter in long. 162° 30′ E., lat. 57° 15′ S., without seeing land or meeting with the Peacock or Flying Fish.

On the 10th of January, being in lat. 61° S., we fell in with the first icelands, and continued steering to the southward among many icebergs, which compelled us to change our course frequently in avoiding them.

On the 12th we ran into the bay of field ice in long. 164° 53′ E., and lat. 64° 11′ S., presenting a perfect barrier to our progress further south; a heavy fog ensuing, during which we parted company with the Porpoise, her commander having directions to follow my written instructions in that event.

I had determined to leave each vessel to act independently, believing it would tend to give, if possible, a greater degree of emulation to us all; and being well satisfied that owing to the ice and thick weather, it would be impossible to continue long in company, I deemed it preferable to hazard the event of accident, rather than embarrass our operations.

I therefore submit the details of the proceedings of this ship, as they will, without doubt, nearly coincide with the movements of the other vessels of the squadron, the reports from which will tend to verify our operations.

After an unsuccessful attempt to penetrate through the ice on the 12th of January, we proceeded to the westward, working along with head winds and fogs, and on the 16th we fell in with the Peacock in long. 157° 43′ E., lat. 65° 26′ S.

On the morning of the 19th of January, we saw land to the south and east, with many indications of being in its vicinity, such as penguin, seal, and the discoloration of the water, but the impenetrable barrier of ice prevented our nearer approach to it, and the same day we again saw the Peacock to the south and west. We were in long. 104° 27′ E., and lat. 66° 20′ S.

On the 22d we fell in with large clusters and bodies of ice, and innumerable ice islands, and until the 25th were in a large bay formed by ice, examining the different points in hopes of effecting an entrance to the south, but were disappointed. We here reached the lat. 67° 4′, in long. 147° 30′ E., being the farthest south we penetrated. Appearances of distant land were seen in the eastward and westward, but all points except the one we entered, presented an impenetrable barrier. We here filled up our water tanks with ice taken from an iceberg alongside the ship.

We made our magnetic observations on the ice. The dipping needles gave 87° 30′ for the dip, and our azimuth compass was so sluggish on the ice, that on being agitated, and bearing taken again, it gave nearly three points difference; the variation being 12° 35′ E. A few days afterwards, about one hundred miles further to the west, we had no variation, and thence it rapidly increased in westerly variation, from which I am of opinion that when in the ice bay we could not have been very far from the south magnetic pole. This bay I named Disappointment Bay, as it seemed to put an end to all our hopes of further progress south.

On the 27th we fell in with the Porpoise, in long. 142° 20′ E., and lat. 65° 54′ S., and parted company shortly afterwards.

On the 28th, at noon, after thirteen repulses, we reached long. 140° 30′ E., and lat. 66° 33′ S., where we again discovered land bearing south, having run over forty miles, thickly studded with icebergs. The same evening we had a heavy gale from the southeast, with snow, hail, and thick weather, which rendered our situation very dangerous, and compelled us to retrace our steps by the route which we had entered. During this gale we were unable to see the distance of a fourth of a mile, constantly passing near icebergs which surrounded us, and rendering it necessary to keep all hands on deck. On the morning of the 30th the gale abated, and we returned by the same route to reach the land, when the dangers we encountered among the ice the preceding night, and our providential escape, were evident to all.

We ran towards the land about fifty miles, when we reached a small bay pointed by high ice cliffs and black volcano rocks, with about sixty miles of coast in sight, extending to a great distance towards the southward, in high mountainous land.

The breeze freshened to a strong gale, which prevented our landing, and compelled us to run out after sounding in thirty fathoms water; and within two hours afterwards the ship was again reduced to her storm sails, with a heavy gale from the southward, with snow, sleet, and a heavy sea, continuing thirty-six hours, and if possible more dangerous than that of the 28th and 29th, owing to the large number of ice islands around us; after which I received reports from the medical officers, representing the exhausted state of the crew and condition of the ship, of which the following are extracts:

The medical officer on duty, reported, under date of the 31st January, that "the number on the sick list this morning is fifteen; most of these cases are consequent upon the extreme hardship and exposure they have undergone during the last gales of wind, when the ship has been surrounded with ice. The number is not large, but it is necessary to state that the general health of the crew is, in our opinion, decidedly affected, and that under ordinary circumstances the list would be very much increased, while the men, under the present exigencies, actuated by a laudable desire to do their duty to the last, refrain from presenting themselves as applicants for the list.

"Under these circumstances we feel ourselves obliged to report, in our opinion, a few days more of such exposure as they have already undergone, would reduce the number of the crew, by sickness, to such an extent as to hazard the safety of the ship and the lives of all on board."

After which, the surgeon, being restored to duty, reported to me as follows:

"I respectfully report that, in my opinion, the health of the crew is materially affected by the severe fatigue, want of sleep, and exposure to the weather, to which they have lately been subjected; that a continuance of these hardships, even for a very short period, will entirely disqualify a great number of men for their duty, and that the necessary attention to the health of the crew and their future efficiency and usefulness, demands the immediate return of the ship to a milder climate."

Deeming it my duty, however, to persevere, I decided to continue, and steered again for the land, which we had named the Antarctic Continent.

We reached it on the 2nd of February, about sixty miles to the westward of the point first visited, where we found the coast lined with solid, perpendicular ice cliffs, preventing the possibility of landing, and the same mountains trending to the westward. From thence we proceeded to the westward along the ice barrier, which appeared to make from the land, until the third, when we again encountered a severe gale from the southeast, with thick weather and snow until the 7th of February, when it cleared up sufficiently to allow us to see our way clear, and we again approached the perpendicular barrier of ice, similar to that which we had previously seen as attached to the land; the same land being in sight at a great distance. We stood along the barrier, about seventy miles to the westward, when it suddenly trended to the southward, and our further progress south was arrested by a solid barrier or field of ice. After an unsuccessful examination for twenty-four hours in all directions, we continued to the westward along the barrier, as usual, surrounded by ice islands.

On the 8th and 10th (being on the 8th in longitude 127° 7′ east, latitude 65° 3′ south,) we had similar appearances of distant mountains, but the compact barrier extending from east to west by south, prevented a nearer approach.

On the night of the 9th February, being the first clear night for some time, we witnessed the aurora australis.

We continued on the 10th and 11th westward, with southeast winds, and fine weather, close along the barrier, which was more compact, with immense islands of ice enclosed within the field ice.

On the 12th we again saw the distant mountains, but were unable to effect a nearer approach, being in long. 112° 16′ E., lat. 64° 57′ S., and I was again compelled to go on to the westward.

The ice barrier trending more to the southward, induced me to hope that we should again succeed in approaching nearer the supposed line of coast. On the 13th, at noon, we had reached long. 107° 5′, lat. 65° 11′ S., with tolerably clear sea before us, and the land plainly in sight. I continued pushing through the ice until we were stopped by the fixed barrier about fifteen miles from the shore, and with little or no prospect of effecting a landing.

I hauled off for the short night, and the next morning made another attempt at a different point, but was equally unsuccessful, being able to approach only three or four miles nearer, as it appeared perfectly impenetrable. Near us were several icebergs, colored and stained with earth, on one of which we landed, and obtained numerous specimens of sandstone, quartz conglomerate and sand, some weighing an hundred pounds. This, I am well satisfied, gave us more specimens than could have been obtained from the land itself, as we should no doubt have found it covered with ice and snow one hundred or more feet in thickness. We obtained a supply of fresh water from a pond in the centre of the same island. Our position was long. 106° 40′ E., lat. 65° 57′ S., and upwards of seventy miles of coast in sight, trending the same as that we had previously seen.

Although I had now reached the position where our examinations were to terminate by my instructions to the squadron, I concluded to proceed to the westward along the barrier, which continued to be much discolored by earth, and specimens of rock, &c. were obtained from an ice island. A sea leopard was seen on the ice, but the boats sent did not succeed in taking him.

On the 17th February, in long. 97° 30′ E., lat. 64° S., land was again seen at a great distance towards the southwest. We now found ourselves closely embayed, and unable to proceed in a westerly direction; the ice barrier trending around to the northward and eastward, compelled us to retrace our steps. We had entered a deep gulf on its southern side, and it required four days beating along its northern shore to get out of it. During this time our position was critical, the weather changeable, and little room in case of bad weather. It fortunately held up until we found ourselves again with a clear sea to the northward.

The ice barrier had now trended to about sixty-two degrees of latitude; the wind having set in from the westward with dark weather, and little prospect of seeing the land or making much progress to the westward prior to the 1st of March, thereby losing time which might be spent to advantage for our whaling interests at New Zealand, I determined to proceed to the north on the evening of the 21st.

There was a brilliant appearance of the aurora australis on the 17th February, in lon. 97° 39′ E., lat. 64° S.; also on the 22d Feb. in 103° 30′ E., lat. 58° 10′ S.; on the 25th Feb. in 117° 31′ E., lat. 53° S.; and on the 1st March, in lon. 147° E., lat. 49° 30′ S.

The result stated in this report leads me to the following conclusions:—

1st. From our discoveries of the land through forty degrees of longitude, and the observations made during this interesting cruise, with the similarity of formation and position of the ice during our close examination of it, I consider there can scarcely be doubt of the existence of the Antarctic continent, extending the whole distance of seventy degrees from east to west.

2d. That different points of the land are at times free from the ice barrier.

3d. That they are frequented by seal, many of which were seen, and offer to our enterprising countrymen engaged in those pursuits, a field of large extent for their future operations.

4th. That the large number of whales, of different species, seen, and the quantity of food for them, would designate this coast as a place of great resort for them. The fin-backed whale seemed to predominate.

We proceeded on our cruise to the northward and eastward with strong gales, until we reached the latitude of certain islands laid down on the charts as the Royal Company's Islands, about six degrees to the westward of their supposed locality; I then stood on their parallel and passed over their supposed site, but we saw nothing of them, or any indication of land in the vicinity. I feel confident, as far as respects their existence in or near the longitude or parallel assigned them, to assert that they do not exist.

The last ice island was seen in latitude 51° south. A few specimens of natural history were obtained and preserved during the cruise.

As I conceive it would be unbecoming in me to speak of our arduous services, the report and accompanying chart of our cruise must speak for us; but I cannot close this report without bringing to your notice the high estimation in which I hold the conduct of the officers, seamen, and marines, during this antarctic cruise, the manner and spirit, together with the coolness and alacrity with which they have met the dangers and performed their duties. I trust that they will receive from the government some gratifying notice of it. All I can say in their favor would fall far short of what they deserve.

I shall ever bear testimony that they have proved themselves worthy of the high character borne by our countrymen, and the navy to which they belong.

I have the honor to be, sir, most respectfully your obedient servant,

CHARLES WILKES,
Com'g Exploring Expedition of the United States.

To the Hon. James K. Paulding, Sec'y of the Navy, Washington City.

Note.—After cruising among the isles of Oceanica, the squadron arrived at the Sandwich isles, October, 1840, having sustained the melancholy loss of Lieut. J. A. Underwood, and midshipman Wilkes Henry, who were murdered July 25, by the natives at Malao, one of the Fejee isles.

2. *Theory of Water Spouts and Tornadoes.*—A few weeks since a large kettle of water, which having been used for washing, was covered with a thick smooth scum of curdled soap, was hanging over the kitchen fire, and though there was no ebullition, a dense volume of steam was rising from it, and with a rapid whirling motion ascending the chimney. My attention was drawn to it from the fact, that the movement of the steam was affording additional proof of the general course of all atmospheric currents from right to left, according to the theory of Mr. Redfield, a theory, of which thus far, we have frequently noticed the verification. The steam whirl formed immediately over the surface of the kettle, and made a column some two or three inches in diameter, for about eighteen inches in length, when it disappeared behind the mantle of the chimney. In the centre of the whirling column of steam, which rotated with astonishing rapidity, a clear space could be seen, distinctly marked by a difference in color, showing that the pillar was a tube. As in obedience to the different currents of air in the room, the column changed its position over the surface of the kettle, we observed the movement was accompanied at times with a curious agitation, which at first was supposed to be mere ebullition; but from its being always under the centre of the column, being most violent where the whirl approached nearest its surface, and shifting position with it, was soon perceived to be owing to that.

The appearance was as if a man's hand was moved under the surface, at times protruding his forefinger upwards, and lifting the scum, or rather forcing the finger through it to its full extent. It occurred to us at once as a fine illustration of the commencement of a water spout, and we continued our examination for some time until the general motion of the surface by boiling prevented any very marked action of the whirl. As the rising fluid evidently ascended the clear space in the centre of the cone or column, it was certain that the column was hollow, and that within the whirl there was a diminished atmospheric pressure. During the times that the water mounted the highest, (which was between four and five inches,) there was a violent agitation of the surface in the immediate vicinity of, or beneath the base of the rotating column, and a careful examination showed that small pieces of the foam were occasionally wrested from the upper part of the rising water and instantly disappeared. It could not be seen that there was any distinct rotation to the elevated water, which swayed and bent with the column of steam.

It appeared to us that from this incident, simple and trifling as it may appear in itself, some valuable inferences may be drawn. The origin of water spouts, in connection with whirlwinds, and the laws that regulate the ascent of water, were well exhibited. That water should ascend to the height it evidently does in water spouts at sea, by atmospheric pressure alone, is not to be supposed; but it is atmospheric pressure that forces the water into the hollow at the base of the cone, and places it in a position to be first acted upon and then lifted by the whirling air. When once the upward current is established, there seems to be no difficulty in continuing it; and, as the water thus lifted must return to the earth by being thrown without the upper circumference of the whirl, or when the column is suddenly separated, by pouring downward with the same volume with which it was rising, it accounts for the deluges of water that at times accompany water spouts.

The action or ascent of the water within the tube also showed that the atmospheric pressure was greatly lessened or removed in the interior of the whirl, and thus explained satisfactorily many of the phenomena that accompany tornadoes or whirlwinds. Thus it has always been found in violent tornadoes, that the windows or gables of buildings that were near the centre of the line of the whirlwind, are almost invariably burst outwards, and frequently directly in the face of the advancing storm. This was particularly noticed at the destruction of Natchez, and at Shelbyville, and cannot be well accounted for in any other way than by the violent expansion of the air within the buildings, when the outer pressure is suddenly taken off.

In many storms or tornadoes, the thunder does not appear in distinct explosions, nor the lightning in separate flashes. On the contrary, there is a continued blaze of fire in the cloud and the roll of thunder is incessant. In such cases, effects are observed which indicate in the line of the storm the continued action of electric energy, and give reason to suppose that the ascending column produced by the whirl forms a perfect conductor, along which the electric fluid descends continuously and not in successive masses. Thus in most tornadoes the trees within their range that are not torn up, have their leaves scorched and withered as if a fire had passed over them, and iron substances, such as farming implements, always exhibit unequivocal evidence of having been submitted to electrical action. This was particularly noticed in the tornado near New Haven. That such is the case, the fact, that in such tornadoes occurring in the night the central part of the whirl appears like a pillar of fire or heated iron, is conclusive evidence. Of such appearance the tornado at Shelbyville, and the one described by Arago near Paris, are examples. If a stream of smoke from a chimney, or a column of heated air from grain or hay in a barn are such conductors, as experience shows them to be, there can be no doubt that such a column as is formed in a whirlwind, reaching from the earth to the heavens, would form one still more efficient. W. G.

Otisco, N. Y. Jan. 1841.

3. *Notice of a new variety of Beryl,* recently discovered at Haddam, Conn.; by* John Johnston, A. M., *Professor of Natural Science in the Wesleyan University, Middletown, Conn.; Corresponding Member of the New York Lyceum of Natural History.*—Read before the Lyceum, Jan. 11th, 1841.—This mineral which I propose to notice, evidently belongs to the species beryl, with which it closely corresponds in its natural properties; but differs from it in color and in the great perfection and exquisite finish of the crystals, as well as some other peculiarities to be hereafter noticed.

The color is mountain green, or perhaps better, milky mountain green, all the crystals possessing a peculiarity which is best described by this word. One terminal plane in nearly all the crystals is perfect, and, like the other faces, possesses an exquisite polish. In most of the crystals the peculiar milkiness ceases near the terminal face, which presents the appearance, as an individual remarked, of having been veneered with green glass. Sometimes this transparent portion is a quarter of an inch thick, but usually it is about the thickness of window glass, which it much resembles. The hardness is about 7.5, which is the same as that of common beryl. The specific gravity of four specimens was found to be as follows, viz. 2.716, 2.717, 2.719, 2.716; that of the common beryl is from 2.678 to 2.732.

On the lateral faces of many of the crystals are numerous rhombic figures, produced by crystallization, like the faces of rhombohedra, which may be supposed to be contained within the crystals, but having their faces a little elevated above those of the former. This appearance, which it is believed has not been observed in the common beryl or the emerald, seems to indicate that the rhombohedron is the primary form of this spe-

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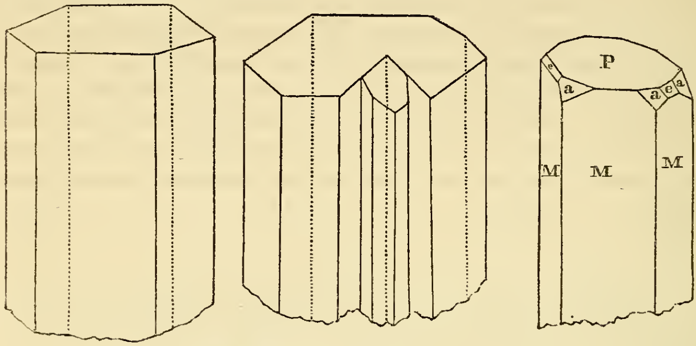
* See Vol. xxxviii, p. 68, of this Journal.

cies, and not the hexagonal prism, as has generally been supposed. A few specimens have been found striated longitudinally like ordinary crystals of the species.

The accompanying figures represent three of the best specimens I have obtained of the natural size.



$$P : a = 134° \ 36'$$
$$P : e = 149 \ \ 40$$
$$M : a = 127 \ \ 44$$

A single attempt at analysis has been made, but without obtaining results in any respect peculiar; a more critical analysis is desirable.

The first specimens of this mineral were discovered in the winter of 1837–8. They occur in a vein of feldspar which traverses one of the gneiss quarries on the east side of the Connecticut river, nearly opposite the Congregational meeting house* at Old Haddam.

Specimens continued to be found, though not very plentifully, for two years or more, but none as I can learn have been found for a year past; and the best ones are now held very high by the workmen of the quarries.

Wesleyan University, May, 1840.

I cannot learn that any more specimens have been discovered since the above date.—Jan. 7, 1841.

4. *Meteorology.*—We invite the attention of our readers and correspondents to a project for generalizing the history of meteoric phenomena, and invite their communications, in compliance with the request of our correspondent, Mons. Morin, engineer of bridges and causeways, and correspondent of the meteorological society of London, who dates from Veroul, 220 miles N. E. of Paris.

As you have been so kind as to view with a favorable eye my meteorological undertaking, I have the honor to solicit you to engage the rea-

* Within six or eight rods of this house is the chrysoberyl locality, at which several other minerals are also found, as the columbite, automolite, zircon, &c.

ders of your scientific Journal to give the history of seasons in America, from the year 1600 to the present year, and to communicate to you the results of their researches.

I have these observations in the United States since the year 1793 to the end of 1837, and some in 1739. I have very few from 1758 to 1600, and few from 1758 to 1793. In the mean time, the recitals of epidemics, of voyages and travels, the history and statistics of agriculture, of the sciences, and of chronology, either printed or in manuscript, may supply the place of regular observations. It will promote these researches, to furnish the means of making them, by pointing out the works where the information may be found.

If I can compile this history for the entire surface of the globe, I think, that by means of tables announced in my eighth memoir, we shall be able to predict the seasons for future times. For those years or points of time where information is deficient, I think that the deficiencies can be theoretically supplied.

Will you, then, I beseech you, by means of your Journal, engage your readers to occupy themselves with this history of the seasons in America, and to communicate to that work the result of their labors? I observe in No. 57, p. 182, (Vol. xxviii,) of your Journal, that New Haven possesses meteorological observations for 70* years.

Can you procure for me the thermometrical mean for December, for each of those years? I intend to prepare the history of the seasons back as far as 1150; as far as regards America, I think it may be carried back to the year 1500.

5. *Royal Society of Northern Antiquaries.*—The labors of this enterprising and distinguished society merit an extended statement at our hands, but owing to the pressure of other contributions, we are unable to give more than a very brief notice.

This society, as is well known, has its seat at Copenhagen, and ranks among its members many eminent and efficient historical investigators of various countries. Its primary object is to bring to light, and to publish with the necessary illustrations, all ancient documents relating to the history and early literature of Scandinavia. It goes farther, and has, with great zeal and ability, prosecuted its inquiries into the history of the Northern adventurers in other countries, especially in America and in the British isles. The society is one of the oldest antiquarian associations in Europe, and has been uncommonly active and successful. As a partial result of its labors, it has already issued more than forty volumes,

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*The passage alluded to by M. Morin, mentioned the cold 70 years ago, but we are not aware that the observations have been regularly continued; we believe they are tolerably continuous for the 40 years past.—*Eds.*

replete with historic lore.* Of these the most interesting to us is the *Antiquates Americanæ, sive Scriptores Septentrionales rerum Ante-Columbianarum in America*, (Hafniæ, 4to. 1837, pp. 486.) This consists of ancient Icelandic histories regarding America, composed chiefly of Narratives of Voyages made to this country by the Northmen, in the 10th, 11th, 12th, and 13th centuries; of course long before the time of Columbus. These are illustrated by critical and historical notes, geographical discussions, &c., concerning the voyages, settlements, and migrations of the Northmen, and with especial reference to the monumental vestiges still remaining in America. The famous inscription on the Dighton rock, (Beverly, Mass.,) is interpreted to assert that *Thorfins* (who was chief of the colony which went from Greenland to Vinland A. D. 1007,) *with a company of* 151 *men, took possession of the country.* After the most laborious research, the editors come to the conclusion that *Vinland* lay at the head of Narragansett Bay, in Rhode Island. Whatever opinion on this subject may finally be considered the true one, the volume in question must be esteemed a most valuable contribution to our history.

In addition to its other publications, the society has proposed to issue their Transactions and Researches concerning the earlier history and antiquities of Northern Europe and America, in two simultaneous periodical works, to be entitled *Annals* and *Memoirs.* In the *Annals*, contributions of the above mentioned nature will be received in Danish or Swedish, (and occasionally in Icelandic,) and wherever it may appear desirable, *maps* will be given, and also *Delineations of Antiquities*, and of the *Monuments* of ancient times. The *Memoirs*, which are inseparably connected with the Annals, will comprise similar contributions in English, French, or German, either original or translated. In English, e. g. will be from time to time inserted the result of the continued investigations and researches of the Society's Committees on the *Historical*

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*The following is a list of some of the publications referred to. Fornmanna Sögur, or *the historical Sagas recording events out of Iceland*, in the original Icelandic, or Old-Northern text; complete in 12 vols. 8vo. Price, vellum paper, $33, common paper, $22.

Scripta Historica Islandorum, the same Sagas translated into Latin, with a critical apparatus; 12 vols. 8vo.

Oldnordiske Sagaer, the same translated into Danish; 12 vols. 8vo. Price, common paper, $17.

Fœreyinga Saga, or the history of the inhabitants of the Faroe Islands, in Icelandic, the Faroe dialect, and Danish, and with a map of the islands; 8vo. $1.75.

Fornaldar Sögur Nordrlanda, vol. 1–3, being a complete edition, in 8vo., of *the mytho-historical Sagas.*

Krakumal sive *Epicedium Ragnaris Lodbroci*, or Ode on the heroic deeds and death of the Danish king, Ragnar Lodbrok, in England; in Icelandic, Danish, Latin, and French; 8vo. $2.

Nordisk Tidsskrift for Oldkyndighed, *Archæological Transactions;* 3 vols. 8vo. $4.75.

Monuments of Greenland, and *on the Ante-Columbian History of America.* Of the Annals, one number in 8vo. is to be published yearly, beginning with 1836, and of the Memoirs, a similar number every second year, commencing with 1838.

We trust that this important society will continue to be regarded with favor by the American people; and that our literary institutions and public libraries will not fail to furnish themselves with its valuable publications.

6. *Fossil Remains in Lenoir County, N. C.*—Extract of a letter to the editors from John Limber, dated Strabane, Lenoir county, N. C., June 10th, 1839.—This location was discovered by Mr. Richard Rouse, the owner of the land, when digging a dike to drain a bog. The location is near the summit level between the Neuse and North East rivers. It is on a branch of the Neuse, three miles from it, and at least one hundred feet above it, and about sixty miles west of Pamlico Sound.

The upper stratum of earth is about three feet in depth, and is the common soil of the region, viz. a fine white sand and vegetable matter. The next stratum is of about the same depth, and is composed almost entirely of *shells*, of a great variety of species; and a still greater variety of sizes. These are cast together in every manner, lying in every position, and shells in shells. Next is a stratum of yellowish clay only a few inches in depth, and containing bones of enormous size. Below this is a stratum of black clay impenetrable by water; depth unknown. This also contains a few bones and in a more perfect state.

On the first of June I visited this location in company with Mr. Rouse, and in two hours we found bones enough for a load to transport home in our arms. Among them was a piece of a rib-bone about two feet in length, which measures three and a half inches in width, and about two and a half in thickness. We also found a tooth of a triangular shape, which is four inches across the base, and about five in length. Mr. Rouse informed me that he had found a part of a tooth, which must have belonged to one four times as large as the one I found: and that he had found a *vertebra* eight inches in diameter. These bones are found in all the strata, but the largest are the lowest. Of the quantity of shells it may not be amiss to say, that there are millions of bushels, and they are beginning to be used for manure.

7. *Removal of Fishes.*—In Dr. Storer's report on the subject of fishes, given at page 378 of the last volume, he remarks, that the only instance with which he was acquainted of the successful removal of a species of fish from one body of water to another in this country, was that of the removal of the *Perca flavescens* from Rockonkoma to Success pond on Long Island, by Dr. Mitchill.

About fifteen years since Mr. Robert Kinyon, then living at the village of Amber on the east shore of the Otisco lake, in Onondaga county, determined to make an effort to introduce into its waters, yellow perch from the Skaneateles, in the waters of which they abound; and pickerel from the cluster of lakes or ponds that constitute the extreme northern sources of the Tioughuioga branch of the Susquehanna river, in some of which this fish is very plentiful. Neither of these fishes had been seen in the Otisco; but suckers, an occasional white fish from the lakes, and the delicious speckled trout abounded in its waters, as well as the smaller fishes common to all our lakes. In the Skaneateles, only three miles distant, were found the perch and the salmon trout, both strangers to the Otisco. A dozen perch of medium size were caught with hooks, put in a barrel of water, and transported from one lake to the other without difficulty. The third year from their removal the Otisco seemed to be filled with them; and I have frequently heard it remarked, that in that and the succeeding year, the perch both for size and numbers exceeded that of any year since in these respects. If we may speak of our own piscatory labors, we may say they were decidedly more successful in those years so far as this fish was concerned, than they have ever been since. A quantity of the pickerel were the same season introduced in the same way, but they have not multiplied; indeed we have never heard of a fish of this kind being taken in the Otisco.

The fine trout that formerly were caught in the lake have gradually become scarce, and are now very rarely taken. This by some has been attributed to the introduction of the perch; but it is believed a more satisfactory cause is to be found in the perseverance and success with which the trout was pursued when entering the inlets or making its beds on the shores in October and November, for the purpose of spawning. Very few that entered the streams escaped, and in this case, the capture of one was frequently the destruction of a thousand.

We have known the common dace and bullpout of this lake, transported some three or four miles to a mill pond, in which they have multiplied to a great extent; the former filling the streams both above and below the pond, while the latter preferred the deep water and muddy bottom of the pond to the clear water of the streams. We imagine there are few if any of our fresh-water fishes, that may not be successfully removed to other locations, should it be found desirable. W. G.

Otisco, N. Y. Jan. 1841.

8. *Stars missing.*—In the volume of Greenwich Astronomical Observations made in 1838, (published in London, 1840, 4to.) the following stars are reported as having been repeatedly sought for, but without success:

A star A.R. 2h. 9m.; N.P.D. 24° 31′, observed with Ramsden's sector, in the Ordnance Survey of England.

A star A.R. 5h. 2m. 51s.; N.P.D. 71° 43′, whose occultation by the moon was observed by Mayer, 1756, September 15. (See Mr. Baily's edition of Catalogue, Mem. Astron. Soc. Vol. iv.)

9. *Ice formed at the bottom of a river.*—In the Journal for April, 1839, page 186, is a letter from Mr. Sheffey on the subject of ice found at the bottom of rivers and seas. The explanation of this perhaps, is, that the rapidity of the current prevents ice forming on the surface; but at the bottom where friction makes the current much less rapid, it becomes possible for the water to turn into ice. If I remember rightly, this is an explanation I heard in Prof. Jameson's Nat. Hist. class, Univ. Edinb. The same reason will apply to seas, where the agitation on the surface prevents freezing; but at the bottom where the water is still, ice is found.

Kingston, U. C., Nov. 5, 1840. T. Stratton.

10. *Depth of the Ocean.*—The sea was recently sounded by lead and line, in lat. 57° south, and long. 85° 7′ west from Paris, by the officers of the French ship Venus, during her voyage of discovery; at a depth of 3470 yards, or 2½ miles, no bottom was found. The weather was very serene, and it is said that the hauling in of the lead occupied sixty sailors more than two hours. In another place in the Pacific Ocean, no bottom was found at the depth of 4140 yards.—*N. Y. Jour. of Com. Nov.* 17, 1840.

11. *Obituary of Ebenezer P. Mason.*—Died at Richmond, Va., on the 26th of December, 1840, Mr. Ebenezer P. Mason, in the 22d year of his age. His last work, the conclusion of an *Introduction to Practical Astronomy*, (8vo. pp. 141,) was finished only three weeks before his death. From the biographical sketch prefixed to this work by Prof. Olmsted, we make the following extracts, in the expectation that an extended memoir will appear in some future number.

"Immediately after completing this treatise, (which he could not be persuaded to leave unfinished,) Mr. Mason yielded to the solicitations of his relatives at Richmond, Va., who had for some time been urging him to hasten to that milder climate, with the hope of preserving, or at least of prolonging, his valuable life. In less than two weeks after he reached his friends, he experienced a sudden prostration, and quietly sunk into the arms of death.

"The present treatise on Practical Astronomy was chiefly written in the spring of 1840, before his health failed. Early the ensuing summer symptoms of consumption began to develop themselves; and hoping to receive benefit from the invigorating climate of Maine, and eager to embrace every opportunity for making astronomical observations, he obtained the post of assistant in the Commission under Prof. Renwick, which explored the northeastern boundary of the United States during the last autumn. Sustained by a temper remarkably cheerful and resolute, he was able to fulfil the duties of his appointment; but on his return, the latter part of October, it was manifest that his disease had made regular progress and was carrying him to the grave.

"Young Mason was truly a man of genius: and short as was his career as an astronomer, he accomplished enough to inspire in his scientific friends the highest expectations of his future eminence in the exalted study to which he had devoted himself. The peculiar assemblage of faculties requisite to form the great astronomer, is seldom found united in the same individual, comprising as it does so many of the higher attributes of genius,—a *hand* of exquisite delicacy to construct and adjust,—an *eye* endued with extraordinary powers of vision to observe,—an *intellect* the most profound to follow out all the consequences of astronomical discovery; and that unconquerable *enthusiasm* which is regardless of loss of rest, of exposure by night, and even of life itself. These qualities were *severally* possessed by Mr. Mason in an unusual degree; but it was their striking and harmonious *union*, which, from the time I first discovered it, led me to recognize in him the promise of one probably destined to enlarge the boundaries of astronomical science." * * *

"This work will, I think be found, on trial, more peculiarly adapted to the exigencies of young students of practical astronomy, than any similar treatise hitherto published; and I cannot but believe that all who peruse it, will unite with me in deploring the untimely fate of a youth, who has given such signal proofs of his capacity to attain to the highest walks of astronomy."

12. *Supplementary Note to Prof. Adams's Catalogue of the Mollusca of Middlebury, Addison Co., Vt.* (See pp. 271, 273.)

Note to Pupa milium.—"By the kindness of Prof. Bronn, of Heidelberg, Germany, I have just received specimens of *Pupa minutissima, Hartm., Rossm.*, &c. (v. Desh. in Lam. An. sans Vert., Pupa, No. 46,) which are very similar in size and form to *P. milium*, but in other respects widely distinct. Ten specimens weigh .06 gr., or .006 gr. each. The remark of Deshayes is 'cette espèce est certainement l'une des plus petites du genre.'"

Note to Helix striatella, Anth.—"Prof. Bronn has sent me from Stiria, Austria, specimens of this species labelled '*H. ruderata, Studer.*' They do not differ in any respect from American specimens, except that one of them has a tinge of green. Anthony's description was published January, 1840. The description of the European author I have not seen; but as the shells were packed by Prof. Bronn only three months later, there is scarcely a doubt that the name *H. ruderata* has the priority."

Middlebury, February 10, 1841. C. B. A

INDEX TO VOLUME XL.

ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

Remarks.—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books, pamphlets, &c., which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from us, that we may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still our endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, in part, retrospective.—*Eds.*

SCIENCE.—FOREIGN.

Societé Royale des Antiquaires du Nord. Rapport des Séances Annuelles de 1838 et 1839. From the *Society*, and from Dr. *J. Porter*.

The Mineral Structure of the South of Ireland: by *Thos. Weaver*, Esq. From the Author.

On the Bowlder Formation; by *Charles Lyell*, Esq. From the Author.

L'Institut, Nos. 334 and 342.

Experimental Researches in Electricity; by Sir *M. Faraday*. 15th, 16th, and 17th series, and Index from 1 to 14. From the Author.

Extrait des Statuts Constitutifs de la Societé des Antiquaires du Nord, with a report of the anniversary meeting of 1838, 1839, and a list of works published by the Society at Copenhagen; avec la liste des membres fondateurs. Report addressed to the British and American members, August, 1830. See p. 212 of this No.

Instructions for the Multiplication of Works of Art in Metal by Voltaic Electricity; by Thomas Spencer, of Liverpool: forming Part IV of Griffin's Scientific Miscellany. Glasgow. 8vo. pp. 62. Price 3*s*. From the Author.

Phrenological Journal published at London, for January, April, and July, 1840. From the Editor, *Hewitt Cottrell Watson.*

On the Diminution of Temperature, with Height in the Atmosphere at different seasons of the year; by Prof. *James D. Forbes.*

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SCIENCE.—DOMESTIC.

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Boston Journal of Natural History, containing papers and communications read before the Boston Society of Natural History, &c. Vol. III, No. 3. Boston, 1840. Little & Co. pp. 124. See this No. p. 196.

A Monograph of the Limniades or fresh-water univalve shells of North America; by S. S. Haldeman, Member of the Philadelphia Academy of Natural Sciences. No. 2. 5 colored plates. Phila. Jan. 1841. Price $1 to subscribers, $1 25 to others. From the Author.

The American Almanac and Repository of Useful Knowledge for the year 1841. Boston. D. H. Williams. pp. 312, 12mo. Price $1. From the compiler, Mr. *J. E. Worcester*.

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Hartford Review, containing an account of the Rock of De Kalb. From *C. Whittlesey.*

Anti-Slavery Reporter, Nos. 10, 11.

Milwaukie Advertiser, Dec. 19, with Governor's Message on the Geological Survey of Wisconsin Territory. From *J. A. L.*

New York Weekly Messenger.

Galena Democrat, with an article on Mining; by S. Taylor. From *John V. Ingersoll.*

The Sun, Baltimore. From *H. W. Ellsworth.* Baltimore Sun, with a notice of the translation of Swedenborg's Economia Regni Animalis.

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THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

PROFESSOR SILLIMAN

AND

BENJAMIN SILLIMAN, Jr.

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FOR OCTOBER, NOVEMBER, AND DECEMBER, 1840.

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PRINTED BY B. L. HAMLEN.

Published at New Haven, Jan. 20, 1841.

Papers by Dr. Hildreth, Dr. Gray, Mr. E. E. Salisbury, Dr. Hare, Dr. J. Lawrence Smith, Prof. C. B. Adams, and Prof. J. W. Benedict, will be inserted in the next number.

Numerous printed papers and books, both foreign and domestic, have been received, and will be found acknowledged in our usual list in this number; some of them will be noticed in due course.

Notices of the valuable work of J. Pye Smith, (2d edition,) and of Dr. Daubeny's Sketch of American Geology, are unavoidably postponed to the next number.

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☞ For an important notice to Subscribers to this Journal, see third page of the cover.

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AMERICAN JOURNAL

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PROFESSOR SILLIMAN

AND

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FOR JANUARY, FEBRUARY, AND MARCH, 1841.

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PRINTED BY B. L. HAMLEN.

Published at New Haven, March 29, 1841.

TO CORRESPONDENTS.

Papers from Drs. Gray, Hare, Locke, Storer and Wyman, and from Messrs. Haldeman and Sullivant, will appear in our next number.—Also, a paper by Mr. W. C. Redfield, on *Fossil Fishes*, and one on the *Hessian Fly*, by Mr. E. C. Herrick.

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ERRATA.

Vol. 39, p. 303, Figure,—the blank segments of circles should extend to the extremity K L of the tube; p. 307, l. 14 from bot after *from*, read *the weight of*.

ADVERTISEMENT.

The announcement, (made on the cover of the January No. of this Journal,) that Prof. J. Liebig's *Organic Chemistry of Agriculture*, would soon be published, by the Junior editor, is withdrawn; another edition of the same work, by Prof. Webster of Cambridge, being already in progress, unknown to the editor at the time his announcement was made.

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