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MISCELLANIES.—DOMESTIC AND FOREIGN.

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THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Notice of the Wonders of Geology, by* Gideon Algernon Mantell, LL. D. F. R. S., author of the Geology of the South East of England, &c. &c.; in two vols. large 12mo., pp. 858. First American from the third London edition.

The rapid progress of geology is evinced, in no way so strikingly, as in the great increase, within the present century, of valuable works upon this noble science. Travellers of high qualifications now give us the results of their geological observations in many countries, and their researches being amply illustrated in many instances by maps and drawings, their works are thus rendered intelligible, both to the learned and those who have not been trained in science.

Even in popular travels, it is not uncommon to find important geological descriptions more or less extended—in paragraphs, in sections or chapters. In consequence of the habit of observation now so generally established, a rich reward is thus presented to the traveller, especially in regions, where man has done little, and nature much.

The same remark is applicable to other branches of Natural History, and it is obvious, that he who is acquainted with all of them need never be without sources of rational enjoyment, while he is amassing treasures for the advancement of science. In geology, many excellent local descriptions have, within a few years appeared. Vast magazines of knowledge are garnered in the Transactions of the Geological Societies of London, of Paris and of other countries.

Many of the scientific Journals abound with geological facts; and numerous elementary treatises, of great value, now place digested information and scientific deductions within the reach of the student.

The excellent works of Smith, De la Beche, Buckland, Daubeny, Sedgwick, Murchison, Bakewell, Thomson, Jameson, Lyell, Greenough, Conybeare, Phillips and others in England and Scotland are well known, and most of them have been mentioned in the pages of this Journal. Continental writers also are numerous and not less distinguished than those of Britain—we may cite Cuvier, the Brongniarts, Humboldt, Boué, De Beaumont, Deshayes, Omalius de Halloi, D'Aubuisson, Von Buch, Leonhard, Bronn and many more, while our own country is fruitful in geological surveys and elaborate reports and memoirs of great value, although it is as yet without any extended *original* elementary treatise on geology.

At present we shall confine our attention to the work named at the head of this article.

The first London edition appeared in March, 1838, and the third only fourteen months after, so rapid had been the sales, indicating a great and deserved popularity. The first and only American edition was in fact, identical with the London third, being printed on the same paper of the same quality and with the same types and illustrations. The title page was so far altered as to shew its adoption here, and an original prefatory discourse, served as a passport to this country, in which the work found an editor in Prof. Silliman, of Yale College, and a pecuniary sponsor, in Mr. A. H. Maltby, of New Haven.

The object of this American adoption was, to secure some advantage to the respected author, (a precedent unhappily as novel as it is just,) and at the same time to bring the work before the American public at such a price, as would enable persons in moderate circumstances to purchase it.

In this view, as we are assured, the expectations of the American sponsors have not been disappointed, notwithstanding the trying times, in the business world, that are now passing over our heads.

In Vol. xxxiv, at p. 387 of this Journal, we gave a favorable account of the first edition of the Wonders of Geology, and it is our object now to say something of the merits of the last edition. We regret that it has lain so long unnoticed by us, but from the pressure of many duties, our power has not been commensurate with our inclinations.

We have, in no degree, fallen off in our admiration of this beautiful work.* In our remarks upon the first edition, we stated our views of the different modes of treating geology, as regards the order. That which Dr. Mantell has followed in all the editions of the Wonders, is from the gravel down through the alluvial and diluvial, the tertiary, the secondary and transition to the metamorphic and the primary rocks, the internal fires and the volcanoes. This order has its advantages, but it requires inconvenient anticipations. An individual who has tried, in courses of lectures, every order that can well be proposed, has come to the conclusion, that the better mode is to begin with the actual volcanic vents—the living fires of our world, connecting with them the dormant and extinct volcanoes—then to descend with the evidences of regularly increasing heat in all the rocks, until we reach the permanent internal fires—permanent in as much as they are never entirely extinguished, although they may fluctuate in position and intensity.

In this manner we arrive, by an intelligible process, at the region of the primary or unstratified rocks, now universally admitted to be of igneous origin, and thus we establish the dominion of fire, all the doctrines connected with which are intelligible and credible, and of commanding and pervading energy, among the dynamics of the planet. We are also thus furnished with the key to the intrusions of the igneous rocks among all the other classes, and among each other, while the particular alterations among the various classes of rocks, by the action of ignited and melted masses, may be reserved for the time when those rocks shall be in turn examined.

From the granite, at which we thus arrive in our descent, we naturally ascend in the chronological order of the strata, beginning with the primary slates, as to whose alledged metamorphic character we may thus be placed in a condition to form a judgment, since the

* Prof. Silliman has had occasion during the late winter to make trial of its capabilities for the instruction of large popular audiences in a public institution. The Lowell Institute at Boston, Mass., founded by the munificence of the late Mr. John Lowell, a native and citizen of that place, who died at Bombay, while on his oriental travels, and left an ample endowment for the support of popular lectures, as well as instruction in exact details on morals and religion, science, philosophy and arts, &c. A geological course was given during the late season, to two audiences, collectively amounting to three thousand people. While Bakewell and other works were recommended to their perusal, the order of Dr. Mantell's Wonders was followed in the lectures for the convenience of the audience.

igneous rocks must supply their materials; at least their materials must come from below, and may be furnished also in part by chemical effluxes from the interior of the globe, a hint that may serve to explain whence the materials of the early calcareous and magnesian rocks are derived. In our continued ascent, we soon encounter the strata containing the oldest fossils, the marine animals that occupied the earliest seas, relics entombed in the transition rocks of Werner, the Cambrian and Silurian of Sedgwick and Murchison. From those profound depths, where animal and perhaps vegetable life approximates to the granite epoch, we follow its continued developments through the immense piles of natural masonry that form the stratified rocks, replete also with the remains of the living beings of succeeding ages, but changing their character continually, as we ascend, until, in ages very remote from those which cherished the earliest forms of life, we discover the beginning of terrestrial existence, of the animals that lived on dry land; and thus at length we arrive at the era of the human race, the last in the order of the creation. In this mode of treating the subject, there are few anticipations, and the chronology is perfectly preserved. The action of water will, of course, be studied through the whole series; it is necessary to have regard to water in solving even the phenomena of fire, and it is of course admitted by all, as the great agent in stratification. We may finish by considering water in its widely ranging effects, as seen at the present time. The phenomena of vallies, rivers, and fountains, and of all that appears on the surface, may be studied in the conclusion of the series, with all the lights that have been afforded by the preceding investigations; nor can we forget the proofs of wise and benevolent design which are apparent through all the formations, and that shine forth so remarkably in the various affections of the surface, the prepared and arranged theatre of human action.

No particular order is however absolutely essential to geology; for begin where we may, we can always revert; we can thread our way, back and forward, as occasion may require, until the labyrinth, at first dark, devious and appalling, becomes illuminated, and we walk securely in the light of science, guided by the clue of strict induction, which leads us, with unerring steps, through all the phenomena.

Dr. Mantell has preserved a strict unity of plan in the treatment of his subject; each division is made perfectly clear and intelligible by itself, and all are united in a consistent harmony and beauty.

The numerous illustrations of the Wonders of Geology are well selected and beautifully executed. Finer wood cuts cannot be found, in any work of science; they are, of course, inserted in the text, and thus the figures and descriptions accompany each other. In studying the organic remains in this work, the student, although without a cabinet, gains great assistance from such excellent figures. Bones and skeletons, and fragments of birds, quadrupeds, and fishes; shells in all their endless variety; corals and coralline rocks; the crinoidea or lily-shaped animals, and all the rich variety of zoophytes, or animal structures, in form, resembling plants; the vegetable remains, especially the leaves and stems, exuberant in the coral formation, beyond the conception and belief of one who is not a geologist; all these are fully illustrated in Dr. Mantell's work, and all necessary sections are appended, shewing the relations of strata, their dislocations, elevations, depressions, inflexions, and lacerations, by intrusive masses. It was evidently an important point, in Dr. Mantell's view, to preserve a manageable form in his volumes by avoiding folded plates, an object certainly very important, and in this work happily attained; but aside from this reason of convenience, we should have wished for sections on a larger scale, especially in the general view of the relations of the groups and families of rocks, giving the strata in more detail, and in more contrasted distinctness.

The order of the subordinate parts of the Wonders of Geology is very good. The physical relation of the earth to the solar and stellary systems is set forth, both in the beginning and conclusion of the work, in connection with some of the grand deductions of modern astronomy; the general classification of the rocks, and the great causes that are operating to produce geological changes, are indicated, and the consistency of the whole with divine revelation is successfully maintained.

It was natural for the author to write with fullness upon the tertiary and secondary formations, since England is so opulent in interesting facts relating to these departments, and Dr. Mantell himself has happily illustrated the tertiary and upper secondary by his own beautiful discoveries, some of them unique and very remarkable.

The fossiliferous formations have assumed a high degree of interest in our times, an interest which is constantly increasing with the progress of geology. In the earlier periods of the science, the primary rocks were the chief objects of investigation, and fossil geology, being little cultivated, was little understood. The primary rocks were viewed as the types of permanency, the primordial foundations laid down in the beginning, and which, as was supposed, had rarely been disturbed in the progress of geological events. But now we cannot assign a period beyond which there has not been change, event, and revolution. Granite itself, in the early systems of geology the very personification of physical antiquity and stability, is now proved to be of all geological ages, anterior to the tertiary; and it would in no manner surprise us, were the progress of discovery to place granite in some of its irruptions, above the tertiary, like the ancient lavas of Auvergne, many of which repose upon the tertiary of that remarkable country.

The light which has burst in upon us from the microscopic discoveries of Ehrenberg, has opened a new world in the mineral kingdom; for none would have expected to find minerals and rocks composed of the silicified, ferruginous, and calcareous petrifactions of infinitesimal animalcules, requiring thousands of millions of individuals, to fill the capacity of a cubic inch.

In all probability, we are to proceed in these discoveries from flint, opal, chalcedony, agate, tripoli, and beds of sand, and clay, and marl, to earlier formations, which also may contain their myriads of invisible animalcules. Dr. Mantell has presented this subject with his usual felicity, and with good figures of many magnified fossil animalcules; while his remarks evince an expectation that even the most ancient rocks may not be exempt from similar evanescent fossils. It is, however, not easy to understand how any organic body can retain its form in the midst of fusion, and although silicified shields of animalcules may be proof, to a certain extent, against fire, we cannot suppose that they can remain, with their characteristic forms, in the midst of granite and porphyry, while the very quartz and feldspar, of which they are so largely composed, have flowed in igneous fusion, or acquired a condition by fire so soft and yielding as to admit of crystallization. The absence, therefore, of traces of animalcules from ignigenous rocks, would not necessarily prove that their materials had not involved a portion of this concealed world, unrecognizable by our unassisted vision, but palpable and unquestionable with the aid of high magnifying powers.*

All these things then, so far from proving that the globe is eternal, do, on the contrary, demonstrate that the present order of things in the mineral world, has had every where a beginning, and therefore we may reasonably infer that matter itself must also have had a beginning, neither its mode nor its substance being eternal. But it is beyond the reach of the human mind, to ascertain when, or in what form of existence, matter was first brought into being by the power of an infinite Creator, to whom space and time are alike without limit, and means of filling them without end.

The selection of subjects by Dr. Mantell is very judicious, and they are combined and arranged in a state of luminous condensation.

Amidst the immense opulence of geological facts, this is no small praise; a happy selection implies, of course, a familiar acquaintance with the whole science, and requires the exercise of a sound judgment, directed by a discriminating taste. If we were to express any regret as to materials, it would be, both in the case of Dr. Mantell and of Mr. Lyell, that the primary rocks are left comparatively in eclipse under the flood of light that is poured in upon the world of fossils. Perhaps we may be under an undue bias on this point, from the predominating influence exerted by the primary rocks upon the earlier condition of geology, both under Werner and Hutton, for fossils were then but little known in comparison with the vast range which they now occupy. It is also true, that upon the plan of arrangement for which a preference has been expressed above, the primary rocks would of course acquire all due consideration, because they would cap the climax of fire, and descending to them through the volcanoes and proving them, as we believe, to be ignigenous, we then cite them as proofs, on a magnificent scale, of the effects of heat, causing even the mountains of granite, or the materials of which they are composed, to flow in fiery liquidity, on a scale commensurate with the height of Alpine peaks, and mountain

* We write, to a certain extent, from personal observation, and may add, that we have lately enjoyed an opportunity of inspecting, in the hands of a friend recently returned from Europe, some of the very specimens of fossil animalcules with which Ehrenberg himself had furnished him.

groups and ranges, and with the foundations of countries and continents. Trained in our earlier years among the granite hills and trap walls of New England, we have associated with them our youthful preference and almost filial veneration.

There is a splendid and magnificent association between the active volcano, with its earthquakes, its thunder, its flames, its ignited ejections, and its rivers of molten rock,—and the deep granite foundations which now exhibit the dignity of repose beneath the superstructure of subsequent formations, although the granite itself was once the victim of fire, and was either raised and injected like the veins and dikes, and lava walls of modern volcanoes, or like the deep lava masses, subsided into quiescence after an ineffectual struggle to throw off or break through an impending ocean, or to rend the incumbent strata of the crust of the earth.

If, however, we are disposed to claim all due respect for our ancient friends, the traps and porphyries, the sienites and the granites, we are delighted with the immense developments of fossils in their successive eras, described and figured as they are with scientific precision and graphic beauty; while they are referred, by the aid of natural history, to those families of organized beings which, in most instances, have still their analogues on earth, although there is perhaps not a single species below the tertiary that is identical with any now existing.

Our elementary works and occasional memoirs, are in this age, rich in figures and descriptions of organic remains. Italy, Germany, Switzerland, France, Britain, and even North America, vie with each other in a zealous and successful cultivation of these branches of natural history. Like the mummies of Egypt, secluded for decades of centuries in their mysterious catacombs, the beings of early geological ages are now disentombed and brought to light, and we do not read with more certainty the ancient condition of the human race in Egypt, when the Nile flowed by the then youthful temples of Thebes, and the solemn avenues of silent and unmutilated Sphinxes, or that of the Romans, when Vesuvius, with its lava or ashes, and eruptive waters, buried Herculaneum, Stabia, and Pompeii, than we now study the inhabitants of the primitive seas; the venerable vegetables of the coal formation; the almost unlimited secular range of the vertebrated fishes; the amphibious or terrestrial dominion of the fossil

Saurians; or the walks of the quadrupeds and the quadrumana, which in the later geological eras, preluded the appearance of man, the last being whom the Creator called into existence. Among all the elementary writers who have described fossils, no one has done it with more perspicuity and felicity than Dr. Mantell. The figures, where they are not his own, are borrowed from the best authorities, and place the forms full before the reader, while his vivid and exact descriptions enable us to realize the existence of the often strange and uncouth beings of the gone-by ages, as if they had been our familiar companions.

The style of the work, although it was very good in the first edition, (as we had occasion to remark, in the observations inserted in this Journal, Vol. 34, p. 387, and already alluded to,) is greatly improved in the present edition. Indeed, it realizes our beau ideal of a familiar and yet dignified philosophical style. It is condensed and luminous, garnished by a graceful flowing elegance, and rising as the subject may require, into the sublime as well as the beautiful.

We are not aware of the existence of any work on any subject of science, which has better claims at once to a place upon the shelf of the philosopher, and upon the centre table of a refined family. While it is full and exact in its details, it is delightful as a readable work of taste, equally entertaining and instructive to the youth of both sexes, who will derive from it not only the most important information in the science of which it treats, but the happiest moral impressions, and the most healthful and useful views of the wise and benevolent designs of the Creator of our world and of all the worlds, that spangle, with their silvery orbs, the azure dome of the heavens.

Dr. Mantell's introductions and summaries, prefixed and appended to his principal divisions, afford great assistance, the former in entering a new apartment in the vast temple which he surveys, and the latter, in remembering the various furniture which it contains, and the permanent instruction that flows from the survey. These general views and deductions are presented in eloquent and impressive language. Detached from the facts on which they are founded, they may be regarded as containing, in connexion, each with the rest, a summary of geological conclusions and doctrines, or geological Institutes.

As a work peculiarly adapted to accompany a course of geological instruction, Dr. Mantell's Wonders of Geology holds a high rank. Its lucid method, with its unity, condensation and perspicuity, renders it a fit text-book equally for class-recitation, or for private reading, or to illustrate a course of lectures on geology. For its extent, no work, we believe, contains a better summary of geological facts and of geological philosophy. It is not to be regarded, however, as (what some might infer from its title) *a mere book of wonders.* The most sober account of geology must indeed be replete with wonders; Dr. Mantell has himself been eminently successful in setting forth the most remarkable, (and there are none more so than those which he has brought to light,) but his book is to be regarded in a higher view; it is indeed, a very exact and comprehensive map of his subject—like other maps, omitting details inconsistent with his scale of dimensions, but remarkably complete for the purpose of the general student, who wishes to give to this science the attention which, in proportion to the encyclopedia of universal knowledge, it richly merits. It is easy, from such a book of Institutes, to follow the different members of the subject in full detail, and for this purpose there are ample aids in periodical works, reports of geological societies, and in treatises on particular subjects, as well as the general philosophy of the science.

Mr. Lyell's great work, his Principles of Geology, replete as it is with the most interesting and instructive discussions, would form a good sequel to such a work as Dr. Mantell's, or to Mr. Lyell's own Elements of Geology, an admirable summary *for an adept in the science.* On both of these works we have expressed our opinions in former volumes of this journal, as well as regarding Mr. Bakewell's now venerable treatise, which, in a fifth edition, still maintains its sway at a period more than a quarter of a century from its first appearance, when geology itself was young. May the respected author, also venerable in years, survive to give a sixth edition of this manly and vigorous work, and as many more as life and power may suffice for preparing. The Manual of Geology of Mr. De La Beche affords excellent details of the comparative geology of different countries, connected by sound philosophical views, which are still further illustrated in his Researches on Theoretical Geology, not to mention his more recent geological survey of the counties of Devon and Cornwall. The Silurian System of Mr. Murchison is a vast store-house of the most valuable and interesting facts, and of the most just deductions.

Dr. Mantell's Wonders of Geology will continue to be a favorite work equally in the geological schools, in the private study, and in the family parlor. It may be read and understood by any intelligent and educated individual; its exact science, sound logic, and dignity of style, insure its acceptance with the learned; its elegance, beauty, and perspicuity, with the polite and refined—and its comprehensive brevity, with the student of the elements of geology.

There is no hazard in predicting that successive editions will be called for, as fast as the author can revise and prepare them. Although arduously engaged in the duties of practical surgery, his position at Clapham Common, six miles from London, is very favorable to constant communication with the learned geologists of the metropolis, and with the geological society; although we have to regret that the rich fields of research, so assiduously and successfully cultivated by the acute and indefatigable author, in the south-east of England, can be explored by him no more; and that his profession and position exclude him from acting in the corps of geological pioneers and explorers who, every summer, take up their lines of march through Britain and the continent of Europe, and who occasionally visit Africa, and Asia, and even America. While however, he has done enough to establish a splendid reputation, as an original and successful explorer, we conceive that a post of usefulness is now assigned him of not less importance, although it may be in a more humble sphere. His highly gifted mind, endowed with all the auxiliary sciences, disciplined at once to accuracy and taste, and prompt to observe and secure every discovery and improvement, will vigilantly watch the progress of geology, and *post it up*, as we trust, by such constant revision, that the successive editions of the Wonders, improved, and *even enlarged* as occasion may require, will continue to reflect, as from a perfect and beautiful mirror, the full face and form of this lovely and splendid science.

That the admired author may long have both the ability and the disposition to continue to perform this signal service to mankind, is our ardent wish and confident hope—*sero in cœlum ascendat.*

As many persons who in this country may read the preceding article may not have seen the Wonders of Geology, by Dr. Mantell, we will now furnish an example of his style and manner, exempt from scientific details, by giving a quotation at some length from the conclusion of his work, believing that all which is necessary to render these general views intelligible, will be found either in the remarks themselves or in our preceding observations.

"*General Inferences.*—Restricting ourselves within the bounds of legitimate induction, and forbearing to speculate on those points which rest on insufficient or questionable data, we may nevertheless venture to draw some general inferences as to the varying physical conditions of our planet, and of animal and vegetable life, through the immense periods contemplated by geology.

"From the remotest epoch in the earth's physical history recognizable by man, to the present time, the mechanical and chemical laws, which govern inorganic matter, appear to have undergone no change. The wasting away of the solid rocks by water, and the subsequent deposition and consolidation of the detritus by heat; the subsidence of the dry land beneath the sea, and the elevation of the ocean-bed into new islands and continents; the decomposition of animal and vegetable substances on the surface, and their conversion into stone or coal, under circumstances in which the gaseous principles were confined; the transmutation of mud and sand into rock, and of earthy minerals into crystals,—these physical changes have constantly been going on under the influence of those fixed and immutable laws, established by Divine Providence for the maintenance and renovation of the material universe.

"And although among the sentient beings which have from time to time inhabited the earth, we discover at successive periods the appearance of new forms, which flourished awhile and then passed away, while other modifications of life sprung up, and after the lapse of ages, in their turn were annihilated; yet the laws which governed their appearance and extinction, were in perfect harmony with those which regulate inorganic matter. Every creature was especially adapted to some peculiar state of the earth at the period of its development; and when the physical conditions were changed, and no longer favorable for the existence of such a type of organization, it necessarily became extinct. Thus we have seen different modifications of animal and vegetable life prevailing at different epochs of the earth's physical history, yet all presenting the same principles of structure, the same unity of purpose; all bearing the impress of the same Almighty hand. The creation of man, and the establishment of the existing order of things—which we are taught both by revelation and by natural records took place but a few thousand years ago—are events beyond the speculations of philosophy.

"It follows, from what has been advanced, that both animate and inanimate nature, linked together by indissoluble ties of mutual adaptation, have been governed by the same mechanical, chemical, and vital laws, from the earliest geological periods to the present time; and that the absence of the fossil remains of whole orders of animals in the remotest periods, although, perhaps, in some measure attributable to the feeble development of those types of being, may have been also dependent on the obliteration of their remains in the igneous rocks by high temperature: at the same time we must not forget, that we are examining ancient ocean beds, and may not yet have explored those parts of their vast abysses in which the spoils of the land are concealed. I need not add, that the assumption of successive creations of new forms of being, adapted to the varying physical conditions of the earth is only modified, not weakened, by this argument.

"What, then, is the result of our inquiry into the ancient state of our globe?—That, so far as our present knowledge extends, all the changes produced by mechanical, chemical, or vital agency, whether on the surface or in the interior of the earth, have been taking place from the earliest periods revealed by geological research; and, as like causes must produce like effects, will continue to take place so long as the present material system shall endure. Thus deposits now in progress may subside to the inner regions of the earth, and by exposure to long continued igneous action, all traces of sedimentary origin may be destroyed; and at some distant period, the metamorphosed masses may appear on the surface in the form of peaks of granite, bearing with them the accumulated spoils of numberless ages. I cannot, therefore, concur in the opinion of those, who imagine that in the granite we see the primeval solid framework of the globe—a consolidated crust formed on the surface of a cooling planet, and subsequently broken up by changes in the temperature of the earth. To me it appears that the only legitimate inference in the present state of our knowledge, is that the solid materials of our globe, at a certain depth, become so entirely changed, as to afford no satisfactory data as to any antecedent period. In no department of natural science is the admirable caution of the philosopher more necessary than in geology—'that we should remember, knowledge is a temple, of which the vestibule only has been entered, and we know not what is contained within those hidden chambers, of which the experience of the past can afford us neither analogy nor clue.'

"*Final Causes.*—Geology, then, does not affect to disclose the first creation of animated nature; it does not venture to assume that we have physical evidence of a beginning; *it does not warrant the attempt to explain the miraculous interpositions of Providence, by the operation of natural laws;* but it unfolds to us a succession of events, each so vast as to be beyond our finite comprehension, yet the last as evidently foreseen as the first. It instructs us, 'that we are placed in the middle of a scheme—not a fixed but a progressive one—every way incomprehensible; incomprehensible in a measure equally with respect to what has been, what now is, and what shall be hereafter.'*

"The new page in the volume of natural religion which geology has supplied, has been so fully illustrated by Dr. Buckland, in his celebrated Essay, that I need not dwell at length on the evident and beautiful adaptation of the organization of numberless living forms, through the lapse of indefinite periods of time, to every varying physical condition of the earth, and by which its surface was ultimately fitted for the abode of the human race. We have seen that the infusoria lived and died in countless myriads, and furnished the tripoli and the opal—that river-snails and sea-shells elaborated the marble for our temples and palaces, and polyparia the limestone of which our edifices are constructed; and that grass, herb, and tree, have been converted either into materials to enrich the soil, or a mineral which should serve as fuel in after ages, when such a substance became indispensable to the necessities and luxuries of civilized man. Thus it is that geology has thrown a new interest around every grain of sand, and every blade of grass; and that the pebble, rejected by the moralist and the divine,† becomes in the hands of the philosopher a striking proof of Infinite Wisdom.

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* Bishop Butler.

† Paley. The remark alludes to the celebrated argument of this distinguished author.

"But ought we to rest content in the assumption that all these wonderful manifestations of Creative Intelligence were solely designed to contribute to our physical necessities and gratifications? Say, rather, that this display of beauty, power, and goodness, was designed to fill the soul with high and holy thoughts—to call forth the exercise of our reasoning powers—to excite in us those ardent and lofty aspirations after truth and knowledge, which elevate the mind above the sordid and petty concerns of life, and give us a foretaste of that high destiny, which we are instructed to hope may be our portion hereafter!

"*Geological theory of Leibnitz.*—If we extend our views beyond the limits of strict induction, and venture to speculate on the condition of our globe in the dawn of its existence, and in those remote periods of which the physical characters are inscribed on the rocks and mountains, it appears to me that the theory of Leibnitz, which embraces the original nebular condition of the solar system, and assumes a former incandescent state of this planet, and its gradual refrigeration, is the only hypothesis in harmony with the present state of astronomical and geological knowledge. The prevalence of a higher temperature in northern latitudes during the deposition of the secondary formations, was indicated by the fossil remains of animals and plants of a tropical character. If we admit of a progressive cooling of the earth, we necessarily infer that in the most ancient epochs, the influence of the internal heat upon the earth's surface was very considerable, and that it gradually decreased, till it arrived at the present condition of things, in which the surface temperature is scarcely, if at all, affected by radiation from within. Assuming then as an established theory, what at present, perhaps, must only be regarded as a highly philosophical and probable speculation, we can readily understand that during the secondary geological eras, the temperature of the surface may have been so augmented by a supply of heat from an internal source, as to have maintained a climate possessing the conditions required for the existence of corals in the seas, and of forests of palms and tree ferns, and swarms of reptiles, on the islands and continents of northern latitudes.* The climate of particular latitudes

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* See an excellent summary of the present state of geological theory in Phillips's *Treatise on Geology.*

would also be materially influenced by the great changes in the relative proportion of land and water, which took place in different geological periods. Thus, as Mr. Lyell has satisfactorily demonstrated, the dry land in the northern hemisphere has been on the increase since the commencement of the tertiary epoch ; not only because it is now greatly in excess beyond the average proportion which land generally bears to water on our planet, but also that a comparison of the secondary and tertiary strata, affords indications throughout the space occupied by Europe, of a transition from the condition of an ocean interspersed with islands, to that of a large continent ; and this increase of the land may in some measure have contributed to that gradual diminution of temperature which the organic remains denote.*

" *Astronomical relations of the Solar System.*—Having thus endeavored to interpret the natural monuments of the earth's physical history, let us contemplate the relation of our solar system to the countless orbs around us. For while astronomy explains that our system once existed as a diffused nebulosity, which passing through various states of condensation, formed a central luminary, and its attendant planets ; it also instructs us, that it is but one inconsiderable cluster of orbs, in regard to the group of stars to which it belongs, and of which the milky-way appears to be, as it were, a girdle ; the solar system being placed in the outer and less stellular part of the zone.† But the astounding fact, that all our visible universe is but an aggregation, a mere cluster of suns and worlds, which to the inhabitants of the remote regions, that can be reached only by our telescopes, would seem but a mere luminous spot, like one which lies near the outermost range of observation, and appears to be a fac-simile of our own—impresses on the mind a feeling of awe, of humility, and of adoration of that Supreme Being, to whom worlds, and suns, and systems, are but as the sand on the sea-shore !

" Again, when conducted by our investigations to the invisible universe beneath us, the *milky-way*, and the *fixed stars*, of animal life, which the microscope reveals to us, we are overpowered with the contemplation of the minutest as well as of the mightiest of His works ! And if, as an eminent philosopher observes,

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* Lyell's Principles of Geology, Vol. I, chap. vii.

† See Mr. Whewell's Bridgewater Essay.

our planetary system was gradually evolved from a primeval condition of matter, and contained within itself the elements of each subsequent change, still we must believe, that every physical phenomenon which has taken place, from first to last, has emanated from the will of the Deity.*

"*Concluding Remarks.*—With these remarks, I conclude this attempt to combine a general view of geological phenomena, with a familiar exposition of the inductions by which the leading principles of the science have been established. And if I have succeeded in explaining in a satisfactory manner, how by laborious and patient investigation, and the successful application of other branches of natural philosophy, the wonders of geology have been revealed—if I have removed but from one intelligent mind, any prejudice against scientific inquiries, which may have been excited by those who have neither the relish nor the capacity for philosophical pursuits—if I have been so fortunate as to kindle in the hearts of others, that intense and enduring love and admiration of natural knowledge, which I feel in my own,—or have illuminated the mental vision with that intellectual light, which once kindled can never be extinguished, and which reveals to the soul the beauty, and wisdom, and harmony of the works of the Eternal, I shall indeed rejoice, for then my exertions will not have been in vain. And although my humble name may be soon forgotten, and all record of my labors be effaced, yet the influence of that knowledge, however feeble it may be, which has emanated from my researches, will remain for ever; and, by conducting to new and inexhaustible fields of inquiry, prove a never failing source of the most pure and elevated gratification.

"It is indeed the peculiar charm and privilege of natural philosophy, that it

'Can so inform
The mind that is within us—so impress
With quietness and beauty—and so feed
With lofty thoughts, that neither evil tongues,
Rash judgments, nor the sneers of selfish men,
Nor greetings where no kindness is, nor all
The dreary intercourse of common life,
Can e'er prevail against us, or disturb
Our cheerful faith, that all which we behold
Is full of blessings!'†

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* Professor Sedgwick. † Wordsworth.

"For to one imbued with a taste for natural science, Nature unfolds 'her hoarded poetry and her hidden spells;' for him there is a voice in the winds, and a language in the waves—and he is

'Even as one
Who, by some secret gift of soul or eye,
In every spot beneath the smiling sun,
Sees where the *springs of living waters lie!*' "*

ART. II.—*Observations upon the Effects produced on Plants by the Frost which occurred in England in the winter of* 1837–8; by Prof. JOHN LINDLEY: abstracted and condensed from the Horticultural Transactions of London.†

IN noticing the disastrous effects of the extraordinary winter of 1837–8 upon the exotic plants suppposed to be hardy, as well as upon many of those indigenous to England, Dr. Lindley first makes some remarks on the state of the weather during the preceding summer and autumn. These are founded chiefly upon observations made in the garden of the Horticultural Society at Chiswick near London.

"The month of April, 1837, was perhaps the coldest and at the same time the most sunless ever remembered. It was 7° Fahr. below the mean of the same month for ten preceding years; and the temperature of May following was 6° below the average. In the latter month, the appearance of vegetation was like what it generally presents a month earlier. * * * * The general temperature of April and May being thus low, and the nights frequently frosty throughout both months, vegetation advanced but little, and only commenced under favorable circumstances in June; plants consequently made the greater portion of their growth after midsummer and during the autumn, at which season the shortness of the days, and an unusual deficiency of sun heat, were insufficient to enable them to complete the process of lignification.

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* Mrs. Hemans.

† *Messrs. Editors*—The memoir with this title, published in the last volume of the Transactions of the Horticultural Society of London, possesses so great general interest, that, on the supposition that few of your American readers will meet with it in its original form, I have made the enclosed copious abstract of the more generally important portions for publication in your Journal, adding a few notes in one or two instances. A. G.

October was nearly 2° below the average of its temperature, and consequently did not contribute its usual share towards maturing the wood of the season. November was fully 3° below the mean. December was seasonable during the first fortnight; but a most remarkable change took place after the 15th. The mean temperature of the last sixteen days of the month was 46°; instead of the temperature which usually occurs at the winter solstice, this corresponds with that generally experienced even after the vernal equinox. The rise of temperature above that of November, was also greater than what takes place between March and April. The thermometer was seldom below 40° at night, and never at freezing. These circumstances all contributed to bring on excitement in the fluids of plants, as was evidently manifested in the production of young shoots by many species. On Christmas day the thermometer in the shade stood at $54\frac{1}{2}$°. In the beginning of January the weather was slightly rainy, and so unusually warm that the lowest temperature observed on the 2d of the month was 41°, and for each of the four first days the thermometer marked 48° in the day, the wind blowing from the S. and S. W. On the 5th the wind shifted to the N. W. and the temperature began to fall, but up to the 7th the thermometer did not sink below 27°. After this the winter may be said to have set in; the weather continued to increase in severity until the night between the 19th and 20th, when it arrived at its greatest intensity, and the thermometer sank in the morning of the 20th to $-4\frac{1}{2}$°, the ground being scarcely covered with snow."

The temperature quoted is from a thermometer placed under ordinary circumstances, but when the thermometer was cut off from the influence of heat from surrounding bodies, the temperature was shown to be much lower; as appears from a subjoined table of observations upon a radiating thermometer during the month of January, in which the minimum temperature on the 19th is −12°. Extended observations on the temperature as observed in many parts of Great Britain, and its effects upon a great number of plants follow, in connection with which Dr. Lindley makes the following important remarks.

"It is only by repeated observations of this kind that we can hope for certain success in the important object of introducing exotic species hardy enough to bear our climate; consequently, to multiply and systematize such observations is one of the most useful employments in which the horticulturist can engage. It is far more likely to lead to results of importance than attempts to acclimatize plants; an object which has already occupied so much time to so little purpose, that I doubt whether any one case of actual acclimatization can be adduced; that is to say, any one case of a species naturally tender having been made hardy, or even hardier than it was originally. Not to mention other cases in point, Cerasus Lauro-cerasus is as tender as it was in Parkinson's time, and yet it has been raised from seeds through many generations; the potatoe retains its original impatience of frost, and so does the kidney-bean; which last might at least have been expected to become hardier, if reiterated raising from seed in cold climates could bring about that result. The many beautiful and valuable half-hardy hybrids, lately provided for our gardens, are no exception to this statement, for they are not instances of a tender species being hardened, but of new and hardy creations obtained by the art of man from parents of which the one is hardy and the other delicate. Acclimatization, in the strict sense of the word, seems to be a chimera."

The tabular view of the effects of the frost upon a great number of species in different places, with the annexed minimum temperature observed at those places, and the detailed observations that follow, afford a very full statistical account of the injury committed. That this injury is due, in many cases at least, not so much to the actual reduction of temperature, as to the condition of the plants produced by the warm weather immediately preceding, and perhaps by the subsequent thaw, is not only highly probable *a priori*, but is confirmed by the recorded effects of that winter upon the plants introduced from colder climates. In other and perhaps the greater part of the instances recorded, the excessive cold to which the plants were exposed, was doubtless sufficient of itself, as Dr. Lindley supposes, to ensure their destruction. The effects produced on the plants indigenous to the United States may be adduced in proof of the former statement. Thus *Fraxinus Americana* was greatly injured in the garden of the Horticultural Society, where the greatest cold was $-4\frac{1}{2}$. This tree is indigenous throughout the State of New York, where it grows to a large size, and endures our severe winters with perfect impunity. From the abstract of the meteorological observations made to the Regents of the University, and published in their annual report, we find that the thermometer during the same winter, sunk from – 8° to – 30° in those portions of the state where this tree is most abundant. It even extends north to the region of the Saskatchawan, according to Hooker. *Andromeda polifolia*, which extends from New York quite to the shores of the Arctic sea, was killed in the Society's garden. *Clethra alnifolia*, which was injured at Sketty by a reduction of temperature to only 15°, bears a much greater cold in New Jersey and New York. On the other hand, *Ceratiola ericoides*, passed the winter uninjured in the Society's garden. *Sideroxylon* (*Bumelia*) *lycioides* was only slightly injured. *Quercus virens*, (live oak,) though killed at Claremont at – 12°, was uninjured in the Society's garden, and at other places; and, above all, *Illicium Floridanum* was unhurt. Of these, the latter is a native of Florida, Alabama and Louisiana exclusively, the very warmest portions of the United States, and none of the others occur north of the low region of North Carolina. The northern limit of *Magnolia grandiflora*, is North Carolina near the sea coast, where the winters are very mild; yet in England it seems to have escaped damage except in one or two instances; while *M. glauca*, which in its native situations endures the winter even of Massachusetts, was much injured in Yorkshire, where the cold was not so severe as in London.

"Not the least interesting of the facts observed during this winter was this, that in those places where the cold was *very severe*, the more plants were exposed the less they suffered, and that on the contrary the more they were sheltered without being actually protected artificially, the more extensively they were injured." Of this a great number of instances are given.

"It is well known that plants in a state of growth suffer more from frost than those which are dormant. * * * This is undoubtedly owing in a great measure, if not exclusively, to their tissue containing much more fluid when in a growing state than when they are dormant. The more succulent a plant or a part of a plant, the more tender it is under equal circumstances. An oak or an ash, is nearly exhausted of its fluid contents by the leaves before the frost sets in, and, in fact, the fall of those organs in deciduous trees is probably caused in part by the inability of the stem to supply them in autumn with an adequate quantity of fluid food: during the winter, but little water is added to the contents of the stem, until after the severe frosts are past and the return of spring, when the sap is attracted upwards by the budding leaves. The winter, therefore, is the dry season of such plants, and, for that reason, the period in which they are least liable to the effects of frost. But if any unusual circumstance alters this habit, the capability of resisting frost is altered with it; and thus the plants mentioned in the instances lately quoted, stationed in warm sheltered situations, were stimulated prematurely into growth, their stems were filled with fluid, and they were, in consequence, affected by frost in a much greater degree than when, from the coldness of a station, they were kept in their ordinary winter condition."

But the concluding portion of this memoir is that which possesses, perhaps, the most general interest: this is the *enquiry into the exact manner in which the death of plants is caused by cold.* To give our readers a just idea of Dr. Lindley's observations on this subject, we are under the necessity of making copious and lengthened extracts from this part of the memoir, as it will not bear much condensation.

"The common opinion is, that frost acts mechanically upon the tissue of plants, by expanding the fluid they contain, and bursting the cells or vessels in which it is enclosed. M. Gœppert, of Breslau, in a paper originally read at the meeting of German naturalists at Leipsig in 1829, briefly abstracted in *Oken's Isis*, for 1830, and translated in the *Edinburgh Journal of Natural and Geological Science, for* 1831, p. 180, denies that this supposed laceration of vegetable tissue takes place. He is represented to have stated, that the changes which plants undergo, when they are killed by cold, do not consist in a bursting of their cells or vessels, but solely in an extinction of their vitality, which is followed by changes in the chemical composition of their juices.

"Professor Morren of Liége, in a paper printed in the fifth Vol. of the *Bulletin de l'Acad. Royale de Bruxelles*, has published some exceedingly interesting observations upon this subject. Like M. Gœppert, he denies the truth of the statement generally made, that frost produces death in plants by bursting their vessels; and he assigns the effect to other causes. His more important conclusions are—1. That no organ whatever is torn by the action of frost, except in very rare cases when the vesicles of cellular tissue give way, but that the vesicles of plants are separated from each other without laceration. 2. That neither the chlorophyll, the nucleus of cells, elementary fibre, amylaceous matter, raphides, nor the various crystals contained in vegetable tissue, undergo any alteration, unless perhaps in the case of amylaceous matter, which in some cases is converted into sugar, no doubt in consequence of the action of some acid formed by the decomposition of the organic parts. 3. That the action of frost operates separately upon each individual elementary organ, so that a frozen plant contains as many icicles as there are cavities containing fluid; the dilatation thus produced, not being sufficient to burst the sides of the cavities. 4. That such dilatation is principally owing to the separation of the air contained in the water. 5. That this disengagement of air by [from?] water, during the act of congelation, is the most injurious of all the phenomena attendant upon freezing; introducing gaseous matter into organs not intended to elaborate it, and bringing about the first stage in a decomposition of the sap and the matters it precipitates; so that with a thaw, commences a new chemical action destructive of vegetable life. 6. That the expansion of the cells and aquiferous organs, drives a great quantity of water into the air-cells and air-vessels, so that the apparatus intended to convey liquid only, contains water and air, while that which is naturally a vehicle for air conveys water. Such an inversion of functions must necessarily be destructive to vegetable life; even if death were not produced in frozen plants by the decomposition of their juices, the loss of their excitability, and the chemical disturbance of all their contents.

"Professor Morren's observations were made upon various plants frozen in the spring of the present year, having been exposed to a temperature of -4° to $+9^\circ$ Fahrenheit. One of his statements I give in his own words. 'In the parenchyma of many plants, and especially in that of succulent fruits, it is easy to ascertain what modifications are caused by frost in the internal organs of plants. If a frozen apple is opened, it is obvious that the ice is not a continuous mass, but that it is a collection of a multitude of little microscopical icicles. Under the microscope the fact becomes evident. We know how excessively hard some fruits become when frozen by this mosaic of icicles, especially pears. If we thaw them, it is seen that on the instant a multitude of air-bubbles are extricated from the juice of the fruit, and that this juice has then acquired new chemical qualities. I wished to ascertain the cause of these phenomena, and the following is what observation has shown me. I studied for this purpose more particularly the tissue of the apple. Each cell is filled with a small icicle which has in its middle a bubble of air. We know, that when water freezes, the crystals so arrange themselves, that the air separated from their mass by the solidification of the liquid is intercalated between their planes. This air also places itself in a mass of congealed water in a regular manner, the nature of which depends entirely upon that assumed by the crystals, as may be seen by freezing water in a cylindrical vessel, when the air-bubbles always assume the form of a very long cone, terminated by a spherical cap. The augmentation of the volume of water is in great measure owing to this interposition of masses of air. All these effects take place in each cell of a frozen apple, which thus increases in size because each cell of its tissue becomes individually larger. When thawed the cell recovers itself by the elasticity of its vegetable membrane, and frozen fruit becomes, as we know, very much shrivelled. Each cell, therefore, acts like a bottle of frozen water, only there is no bursting, because the membrane is extensible.' But when plants, easily killed by cold, are exposed to so low a temperature as that just described, it is to be feared that phenomena actually connected with the destruction of vegetable life may be intermixed with others, which merely indicate the principal effects of cold upon vegetable matter already dead. For the purpose of judging how far this conjecture is well founded, I have carefully examined the post mortem appearances of several plants killed by exposure to a temperature artificially reduced only to from 28° to 30° Fahrenheit. These observations, while they have confirmed the general accuracy of Professor Morren's statements, have led to other conclusions, which also appear important." In these cases Dr. Lindley remarks that he did not find the vesicles of cellular tissue, separable from each other, even in the most succulent species, whence he concludes that this result is not essentially connected with the destruction of vegetable life, but is the effect of a great intensity of cold upon the tissue. In several instances, however, he found the tissue lacerated, as if by the distension of the fluid it had contained; and sometimes he found the cells so completely broken up, that it was difficult to obtain a thin slice for examination. The young shoots of several species of Erica, and of some other plants, were shivered into a thousand pieces in the Horticultural Society's Garden, and a few cases are cited in which the bark and trunk of trees was rent.

"The expulsion of air from aeriferous organs, and the introduction of it into parts not intended to contain it, is a striking phenomenon. Every one must have remarked that when a leaf has been frozen to death, it changes color as soon as thawed, acquiring a deeper green, and being nearly of the same depth of color on both sides; the same appearance is produced by placing a leaf under the exhausted receiver of an air-pump, and in both cases is owing to the abstraction of air from the myriads of little air-chambers contained in the substance of this organ. If the leaf of Hibiscus Rosa-Sinensis, in its natural state is examined, by tearing off the parenchyma from the epidermis with violence, it will be found that the sphincter of its stomates, the cells of the epidermis, and the chambers immediately below the latter, are all distended with air; but in the frozen leaf of this plant the air has entirely disappeared, the sphincter of the stomates is empty; the upper and under sides of the cells of the epidermis have collapsed and touch each other, and all the cavernous parenchyma below the epidermis is transparent, as if filled with fluid. Whither the air is conveyed is not apparent; but as the stomates have evidently lost their excitability, and are in many cases open, it may be supposed that a part of the air at least has been expelled from the leaf; and as the pith of this plant in its natural state, contains very little air, and in the frozen state is found to be distended with air, it is also probable that a part of the gaseous matter expelled from the leaf when frozen is driven through the petiole into the pith. In the petiole of this plant are numerous annular and reticulated vessels, which under ordinary circumstances, are filled with air, but after freezing are found filled with fluid; is it not possible that their functions may have been disturbed by the violent forcing of air through them into the pith, and that when that action ceased, they were incapable of recovering from the overstrain, and filled with fluid filtering through their sides? That annular ducts are in some way affected by frost, was shown by their state in a thawed branch of Euphorbia Tirucalli, when they were found in a collapsed state, empty of both air and fluid, with their sides shrivelled, and with the fibre itself, which forms the rings, also wrinkled transversely. The minute long-haired leaves of Erica sulphurea are in their natural state firm, bright green, with a rigid petiole, and upon being exposed to pressure in a *compressorium*, offer at first perceptible resistance to its action, and afterwards, as the pressure increases, discharge, chiefly through their petiole, a great quantity of air. But the leaves of this plant which have been frozen by exposure to the temperature of 27° are very different; they are softer, dull olive-green, with a flaccid petiole, and offer but little resistance to pressure; yet, although they give way freely, the quantity of air which the compressorium expels is comparatively small, and readily driven out. Moreover, the long hairs of this plant, which in the natural state are occupied by fluid, were always found filled with air after freezing, and this without pressure having been exercised upon them. I am inclined to refer to this cause the well known fact, of which many cases have occurred this winter, that the sudden exposure of frozen plants to warmth will kill them; though they may not suffer if warmed gradually. In such cases, it may be supposed that the air, forced into parts not intended to contain it, is expanded violently, and thus increases the disturbance already produced by its expulsion from the proper air-cavities; while on the other hand, when the thaw is gradual, the air may retreat by degrees from its new situation without producing additional derangement of the tissue."

The action of frost upon the chlorophyll, or green coloring matter of leaves, is next noticed; and also upon the amylaceous matter, or starch, which is so abundant in many plants. This last is always found to be diminished after freezing, and more or less altered; and in the well known case of the potatoe, the starch which has disappeared is supposed to have furnished the sugar formed in the process of freezing this tuber.

"Finally, it appears that frost exercises a specific action upon the latex, destroying its power of motion. If, as Prof. Schultz supposes, this is the vital fluid of plants, such a fact would alone account for the fatal effects of a low temperature. In all the cases I have observed frost coagulates this fluid, collecting it into amorphous masses.

"In Stapelia, where the laticiferous vessels are easily found, the latex itself is so transparent, that it is difficult to perceive it in a living state, even with the best glasses; but after freezing it is distinctly visible, resembling half coagulated water. In the Hibiscus above mentioned, the stem is covered with long and rigid simple hairs, filled with a plexus of laticiferous vessels of extreme tenuity, but in which the motion of the latex may be seen beautifully with the one-eighth of an inch object-glass of an achromatic microscope. Upon being thawed after freezing, all this apparatus is found reduced to some misshapen separate sacs of fine grumous matter in which no motion can be detected. That these vessels lose their vitality after freezing, may indeed be seen without the aid of a microscope ; for if a stem of a Ficus elastica, or an Euphorbia, or any such plant, which discharges an abundance of milk when wounded, be first frozen and then thawed, no milk will follow the incision.

" From these facts, I think we must draw the conclusion, that the fatal effect of frost upon plants is a more complicated action than has been supposed ; of which the following are the more important phenomena :

" 1. A distension of the cellular succulent parts, often attended by laceration, and always by a destruction of their irritability.

"2. An expulsion of air from the aeriferous passages and cells.

"3. An introduction of air, either expelled from the air-passages or disengaged by the decomposition* of water, into parts intended exclusively to contain fluid.

"4. A chemical decomposition of the tissue and its contents, especially the chlorophyll.

" 5. A destruction of the vitality of the latex, and a stoppage of the action of its vessels.

" 6. An obstruction of the interior of the tubes of pleurenchyma (woody fibre) by the distension of their sides.

" These phenomena may be considered in part mechanical, in part chemical, and in part vital. The two latter are beyond our control. * * * The mechanical action of frost may, however, undoubtedly be guarded against to a great extent. It is well known that the same plant growing in a dry climate, or in a dry soil, or in a situation thoroughly drained from water during winter, will resist much more cold than if cultivated in a damp climate, or in wet soil, or in a place affected by water during winter. Whatever tends to render tissue moist will increase its power of conducting heat, and consequently augment the susceptibility of plants to the influence of frost ; and whatever tends

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* Or rather *disengaged* from the water, which held it in solution, during the act of freezing. A. G.

to diminish their humidity will also diminish their conducting power, and with it their susceptibility. * * * The destructive effects of frost upon the succulent parts of plants, or upon their tissue when in a succulent condition, may thus be accounted for independently of the mechanical expansion of their parts; indeed, it is chiefly to that circumstance that Dr. Neuffer ascribes the evil influence of cold in the spring; for he found, that at Tubingen nearly all trees contain eight per cent. more of aqueous parts in March than at the end of January; and the experience of the past winter shows that the cultivation of plants in situations too much sheltered, where they are liable to be stimulated into growth, and consequently to be filled with fluid, by the warmth and brightness of a mild, protracted autumn, exposes them to the same bad consequences as growing them in damp places, or where their wood is not *ripened*, that is to say, exhausted of superfluous moisture, and strengthened by the deposition of solid matter, resulting from such exhaustion."

ART. III.—*Miscellaneous Notices* on Galvanic results, in letters addressed to Prof. Silliman, October* 4, 1838, *and August,* 6, 1839, *from the vicinity of London;* by WILLIAM STURGEON, Esq.

REMARKS BY THE EDITORS.

THE invention of the constant battery by Prof. Daniel of the Royal Institution, and its modifications and improvement by successive investigators, are more or less known to the scientific public.

A very economical and efficient arrangement of this nature was adopted by several members of the London Electrical Society, and a report of the construction and performance of the battery, in a series of experiments performed at Clapham Common in the autumn of 1838, is contained in the report of Mr. Charles V. Walker, published in the Transactions of the London Electrical Society, in two papers dated October 16, and November 6, 1838. In allusion to this battery, Mr. Sturgeon observes, in his letter of October 9, 1838:—

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* Their earlier appearance has been accidentally prevented.

"A voltaic battery has been got up (at the expense of two of our leading men, whose names I am not at liberty to mention,) for the sole purpose of investigation. The battery consists of one hundred and sixty porcelain pint jars, each containing a copper and zinc cylinder; the latter being covered with stout brown paper, is introduced to the interior of the copper. The exciting fluids are solutions of sulphate of copper and muriate of soda; the former applied to the copper cylinders, and the latter to the zinc ones. When the jars were in series the flame was upwards of an inch long, from a charcoal point, rotated on the poles of a magnet, according to the principles of electro-magnetism. Davy *deflected* the electrical flame by magnetic influence, but I am not aware that he *rotated* it."

"Sulphuret of lead (galena,) was decomposed, and metallic lead obtained. Sulphuret of antimony was decomposed, and the liberated metal kept in fusion for several minutes. The boiling antimony was *three inches long* and half an inch wide between the polar wires, and exhibited a beautiful spectacle, in a channel of those dimensions which the action had formed in the native sulphuret. When the electric flame was directed through the air between stout copper polar wires, the positive wire became red hot, but the negative wire could not be made red. The wires were made to change poles, still the same thing occurred: nay, even two inches of the positive wire, which was completely out of the circuit, was rendered hot, but no redness appeared on the negative wire. How exceedingly curious and interesting is this last result!

"When the whole battery was formed into eight groups of twenty jars each, and properly connected with an electro-gasometer, the mixed gases were liberated from water at the rate of one cubic inch per seven seconds: and this for many successive minutes, although the battery had been in action for seven previous hours without interruption."

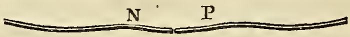
In his letter of August 6, 1839, Mr. Sturgeon proceeds to observe, that a good description of the apparatus and experiments will be found in the memoir above named, and of which he kindly transmitted a copy. But he remarks: "there are some particulars connected with the discovery of the *difference of temperature*, produced in the positive and negative wires, which want a clearer description than any given by Mr. Walker, or, perhaps, any which that gentleman had then a means of giving; and, as I find, from the defective information which has been given of this particular discovery on the continent of Europe, that M. De la Rive and others, have failed in reproducing the curious phenomenon, it is possible that the American philosophers may also fail from a like cause, were the particulars of manipulation not made known to them. I will, therefore, for the information of all the readers of your excellent Journal, give a brief historical sketch of the whole business."

"The battery consisted of a hundred and sixty white porcelain jars, each of the capacity of about two thirds of a pint, and furnished with a hollow cylinder of sheet copper, and an interior hollow cylinder of sheet zinc, the latter amalgamated, and in metallic connexion with the copper of the next pot, &c. The copper and zinc of each pot were separated from each other by a diaphragm of brown paper, (a disc, on the centre of which is placed the centre of the base of the zinc cylinder, and the periphery brought up to the upper end of the latter so as to form a bag round the zinc,) which separates the solution of sulphate of copper, which is placed *outside*, from the solution of common salt, which is placed *inside* of it. Hence the copper is washed with its sulphate solution, and the zinc with the muriate of soda solution.

"One hundred of these metals and pots were furnished by Mr. Gassiot, and the other sixty by Mr. Mason. The preparation of a battery of this kind and extent is a great labor, as you will understand from the following particulars. Mr. Walker commenced working at it between eight and nine in the morning; Mr. Mason arrived about eleven in the forenoon, and immediately set to work at it; Mr. Gassiot commenced shortly afterwards, and it was not ready for experiment till three in the afternoon, about an hour and a half after I arrived at Mr. Gassiot's house. The plan of dividing the battery into groups for the experiments on decompositions, was formed by Mr. Mason, who is a very skillful and neat experimenter. At a previous meeting I was requested to provide a catalogue of experiments, which I did; but in consequence of the great length of time occupied in the experiments on the decomposition of water by the various forms of the battery, only a few of them were attempted. As the decompositions are very well described by Mr. Walker, it would be unnecessary to say any thing more about them in this place. They were carried on with great exactness in the following manner. The graduated glass tube of the electro-gasometer being filled with acidulated water and inverted over the platinum terminals of the instrument, one of the polar wires of the battery was connected with it, and the other kept in the hand of the experimenter ready to plunge into the other mercurial cup of the instrument the moment the word "time" was given, and taken out again when a cubic inch of the gases was collected. Mr. Gassiot marked the time by a stop-watch, Mr. Mason and myself were in turns the experimenters, and Mr. Walker recorded the facts as they were reported to him.

"With regard to the experiment in which I discovered the great difference produced in the two polar wires, it was undertaken from the views which I had long entertained concerning the non-identity of the *electric* and *calorific* matter, as you will see I have hinted at, at the close of section 1, of my first memoir to the London Electrical Society. It was late in the evening before I had any opportunity of making the experiment. The rest of the party were engaged in something else at the time, and the battery was in series of one hundred and sixty pairs. I brought the tip ends of the polar wires (copper wire one tenth of an inch diameter) into contact, end to end,

Fig. 1.

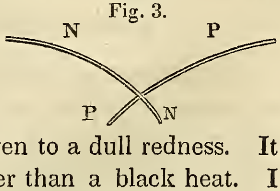


thus, (Fig. 1,) then withdrew them gently and very gradually from each other, keeping the flame in full play between them till they were separated about one fourth of an inch, thus, (Fig. 2.) In a few minutes the positive

Fig. 2.

wire at P got red hot for about half an inch, but the negative wire never became red. I repeated this several times, in order to be convinced of the fact. I next laid the wires across one another, and brought them into contact about an inch from the extremities, thus, (Fig. 3,) and separated them as before. In a short time the whole of that part from the point of crossing to the extremity P, became

Fig. 3.



very red hot, but the N end never got even to a dull redness. It was certainly very hot, but never higher than a black heat. I next increased the length of the ends of the wires *exterior* to the circuit; and eventually heated two inches of the positive wire to bright redness; but no such heat took place on the other wire. Thus satisfying myself that I was not mistaken, I called Mr. Mason to come and look at it; and after satisfying that gentleman by an experiment or two, we called Mr. Gassiot and Mr. Walker to come and witness the novel phenomenon. We now changed the places of the polar wires, making that positive which before had been negative, &c. Still the positive wire showed the same fact. You will easily understand that I experienced a great degree of pleasure at the appearance of this beautiful fact, which seemed to demonstrate the justness of the hypothesis I had so long formed. *No two bodies can be in the same place at the same time*, is an old axiom in philosophy. Hence the blacksmith is enabled to heat his iron rod or nail, by compressing the calorific matter; the blows of his hammer forcing it from the *cavities* into the *particles* of the metal. Thus, also, the electric fluid forces the calorific matter from its natural lodgings in the conductor, and drives it on even to beyond the electrical stream, to take refuge, in a compressed form, in the extremity of the positive wire. Nothing can be more simple to explain; nor do I know of an experiment that tends more to support the doctrine of *one species* of electric matter only; and that it moves through the voltaic conducting wires, *from* the positive *to* the negative pole. I have more experiments on this point, but they are not yet in a *passable* form.

"To produce the phenomenon I have been describing, requires an extensive series of pairs; certainly not less than one hundred and twenty, but two hundred would answer much better, as much depends upon the play of the fluid between the wires; and I think that the battery is quite as well when not highly charged. I have mentioned one hundred and twenty as the shortest to insure success, although it is possible that one hundred might shew the fact."

Extracts from the Memoir of Mr. Walker.

"An interesting phenomenon presented itself, in the deflagration of mercury. The wires used to connect cell 1 and cell 160 with the decomposing or other apparatus were of copper, $\frac{1}{16}$th inch in diameter, well insulated with Indian-rubber cloth, and covered with Indian-rubber cut from thin sheets. When the negative wire was placed within a cup of mercury, and the positive brought to within the striking distance, a most brilliant combustion of the metal took place. When the positive was placed in the mercury, and the *negative* brought to the striking distance, the brilliancy of the combustion was so increased that it was painful to behold it."

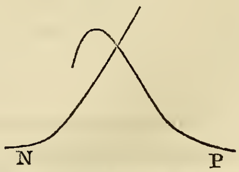
"The length of flame obtained from the charcoal points was three fourths of an inch. The end of a steel file was melted by the flame; so also was glass. Zinc turnings were speedily deflagrated, and their oxide was seen floating about the room. The physiological effects were exceedingly powerful: it required the strongest nerves to volunteer the experiment. The deflagration of metals, and those other phenomena which are attractive to the eye, were of the most brilliant description.

"It was half past 10, P. M. before we had arrived at this portion of the experiments, the battery having been in active operation upwards of 7 hours, and after 5 hours of excitation its power was scarcely impaired. It had been, towards the close, fed, by dropping a few crystals of sulphate of copper into the solutions; but these latter were by no means exhausted; for, on disarranging the battery, the solution remaining in the cells was found fit to use on an ensuing evening, when many members of this Society had an opportunity of witnessing some of those effects, which attach so much value to this simple form of the battery.

"On applying a powerful magnet, the flame from the charcoal points obeyed the known laws of electro-magnetism, being attracted or repelled as the case might be; or following the motion of the magnet, if the latter were revolved."

"When the ends of the main wires were placed across each other, (at about one or two inches from their extremities,) not touching, but with an intervening stratum of air,—the striking distance, through which the electricity passed, producing a brilliant light, that wire connected with the *positive* end of the battery became red hot, from the point of crossing to its extremity. The corresponding portion of the other wire remained comparatively cold. This experiment was carefully repeated and varied. The wires were removed from the battery; that which had been the positive was made the negative, and the

Fig. 4.



negative the positive. The results were still the same. The positive became in all cases heated, from its end to the point of crossing, nor could any coaxing, if I may use the term, produce the same effects in the other, even though the portion beyond the spot where the wires crossed was reduced to the smallest amount. The heat in the end of the positive wire P was so great, that it bent beneath its own weight." (See fig. 4, p. 33.)

"With the battery of one hundred and sixty cells, the arrangement *not* in series is *five*-fold more efficacious than that *in* series, when the electrolyte is *acidulated* water, and the arrangement *in* series is *ten*-fold more powerful than that *not* in series if the electrolyte be *distilled* water."

"We were now induced to repeat that interesting experiment wherein the end of the positive wire became heated to redness, with the following variations:—The wires were crossed as before, and their ends placed into two separate small jars, *a*, *b*, (Fig. 5,) containing distilled water, at the temperature of 58°. In five minutes the temperature of the cell *b*, containing the negative wire, rose to 61°, being 3°,—that of the positive cell *a* to 64°, being 6°.

"They were then similarly placed into two small glass vessels of distilled water; in about two minutes the water in the cell containing the positive wire boiled, that in the other presenting no such appearance.

"When two drops of water were placed on a piece of glass, and the wires touching the water, that at the positive, as might be anticipated, evaporated instantly.

Fig. 5.

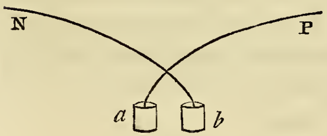
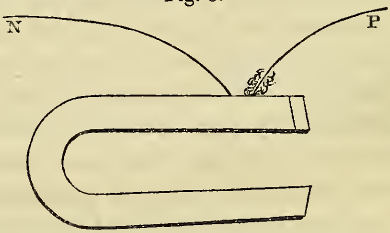


Fig. 6.



"In concluding this account, I have to describe a peculiar phenomenon of a most interesting character, observed by causing a portion of a magnet to form part of the circuit. The other magnetic effects, which shewed the electric flame, obedient to the same laws governing a wire through which the electricity passes, having been repeated, a powerful horse-shoe magnet was held horizontally with its *north* or marked end uppermost; the wire from the negative end of the battery was firmly pressed upon the magnet, and the positive wire brought to within the striking distance, when we had the pleasing satisfaction to observe a brilliant circular flame of electrical light, revolving from left to right, as the hands of a watch. When the position of the magnet was reversed, and the effect obtained from the *south* or unmarked end of the magnet, the flame revolved from right to left. The appearance of the flame was not unlike that of the brush from an electrical machine received on a large surface, only much more brilliant."

Conclusion.—The following remarks, in answer to enquiries made of Mr. Sturgeon as to his views regarding the best forms of galvanic batteries, are worth preserving, as the conclusions of so experienced an experimenter, and the more so as they coincide generally with the views of Dr. Hare, and of other distinguished men in this country.—*Eds.*

Form and size of Galvanic Batteries.

"With respect to galvanic batteries, we can never expect to find *one* which will exhibit every class of phenomena to the best advantage. The pile, with moistened card board in pure water, or a well constructed Cruickshank, charged with water, answers best for charging Leyden jars, deflections of pith balls, &c. And the more extensive the series the better. The size of the plates has also much to do in this business. A single pair of plates, charged with dilute nitrous acid, answers best for most electro-magnetic experiments. For a display of *brilliant* calorific phenomena, the burning of charcoal, deflagration of laminated metals, &c., a series of not less than a hundred pairs answers better than any smaller series. Here again, the size of the plates should never be less than four inches square. Six inch plates answer much better, and two hundred better than one hundred, &c. And these may be either of the Cruickshank form, or of any other, observing that the action with the former is of much shorter duration than with the Wollaston form, and shorter with the Wollaston than with the battery of jars before described.

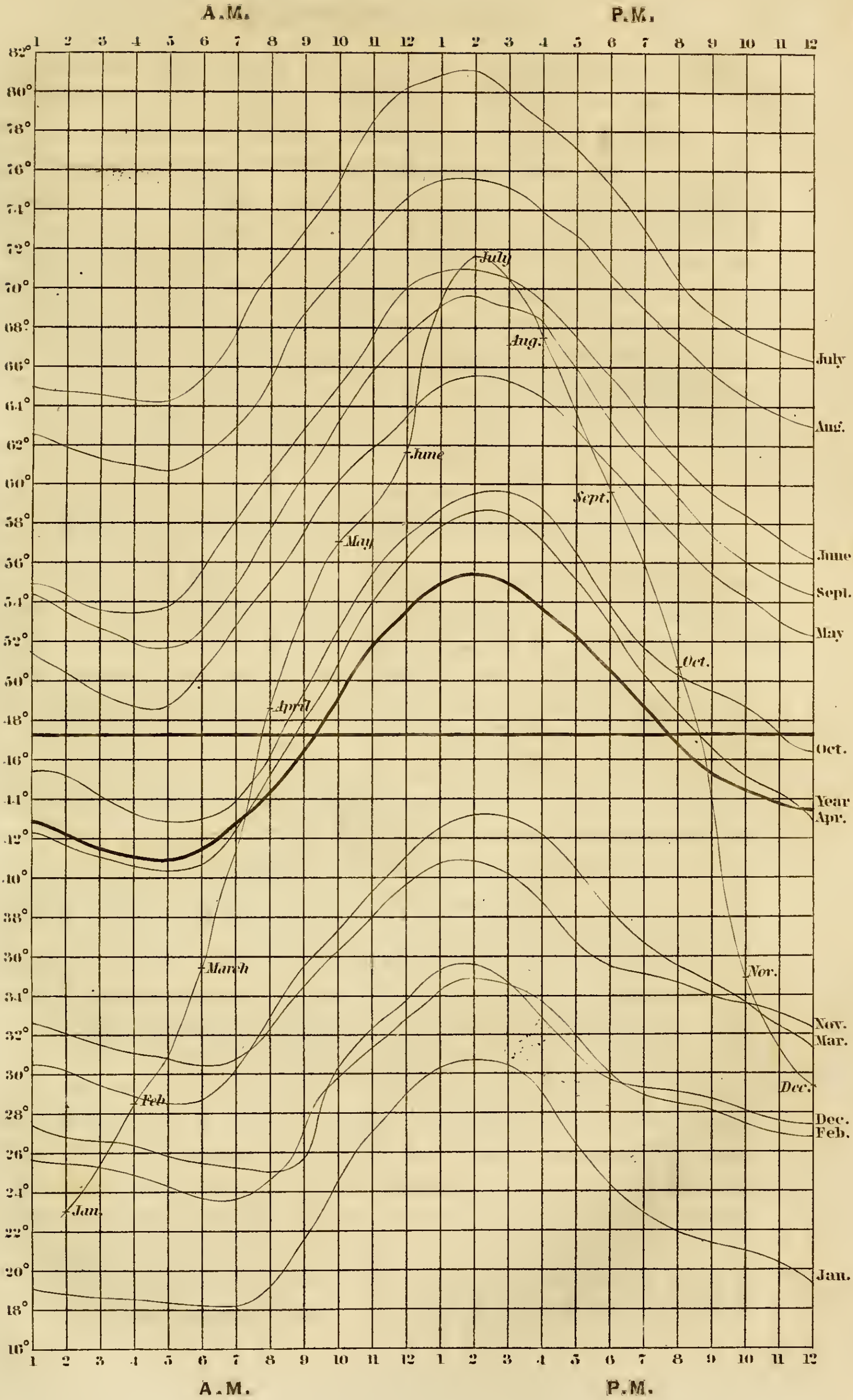
"Then again, for heating of thick wires, a series of ten or less, of *large plates*, are better than more extensive series.

"For chemical decompositions, there is, perhaps, no battery known so well adapted for them as the jars which I have described. Their sustaining power is a great recommendation. The extent of series will necessarily vary with the nature of the compound operated on. We have found that a series of twelve jars gives a sufficient intensity for the decomposition of acidulated water, (water 10, sulphuric acid 1, or even much less.) Twenty-four jars in a double series of twelve, give about twice as much gas as a single series of twelve. But twenty-four jars in a single series, do not give so much gas as when they form a double series of twelve. Again, thirty-six jars in one series, do not give so much gas as when they are formed into a treble series of twelve. Hence, a series of twelve of *these* jars seems to be about the best *unit of intensity* for acidulated water. Other compounds will require other *units of intensity* to produce maximum effects—and other batteries will require different extent of series to produce the same *unit of intensity* as that produced by the jars.

"As far as my knowledge extends, I cannot point out any electro-magnetic apparatus so likely to suit you as those described in Vol. XLIII of the Transactions of the Society of Arts. They are those I still operate with, and I am not aware of any improved method of showing the principal experiment. Those described by Dr. Page are very neat, and might answer for the lecture table very well. Almost every experimenter has some piece of apparatus of his own contrivance, but I think there are none of much use to you beyond those made public."—*Letter to Prof. Silliman.*

Art. IV.—*Facts relative to the temperature of the year, as deduced from a series of observations made at Amherst College, in* 1839; by Prof. E. S. Snell.

Wishing to ascertain as nearly as possible the mean temperature of this place, and likewise to determine what two or three daily observations would furnish that mean for the several seasons of the year, I proposed to the students, at the beginning of 1839, to commence a series of hourly observations of the thermometer. Nearly all the members of the college very cheerfully and generously engaged in the plan, each individual in his turn recording the temperature twenty-four times in as many success-


A.M.
P.M.
82°
80°
78°
76°
74°
72°
70°
68°
66°
64°
62°
60°
58°
56°
54°
52°
50°
48°
46°
44°
42°
40°
38°
36°
34°
32°
30°
28°
26°
24°
22°
20°
18°
16°
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
July
Aug.
June
May
Sept.
Oct.
April
March
Feb.
Jan.
Nov.
Dec.
July
Aug.
June
Sept.
May
Oct.
Year
Apr.
Nov.
Mar.
Dec.
Feb.
Jan.

ive hours. The record was, however, discontinued every week from Saturday, 7, P. M. to Sunday, 7, P. M. During a part of the long autumnal vacation, when few students remained in town, the record was made but once in two or three hours by night, and the intermediate numbers were supplied by interpolation. Throughout the year, I almost every day attended personally to the location of the thermometer, that it might have such an exposure as to indicate correctly the temperature of the air. The entire number of observations was seven thousand five hundred and twelve, distributed equally through the year, or about six hundred and twenty-six each month. The following table exhibits the mean temperature of the several months, and of the year, according to Fahrenheit's thermometer.

Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
22°.94	28°.57	34°.81	48°.54	56°.92	61°.60	71°.61	67°.44	59°.80	50°.46	34°.80	29°.28	47°.23

Besides the daily, monthly, and annual averages, I also obtained the averages of the *corresponding hours* for every month, and for the year. Thus, in January, the mean temperature at 1, A. M., was 19°.04; at 2, A. M., 18°.70, &c. All these results are presented at once to the eye in the plate, in which the mean diurnal changes of each month are represented by a curve, whose coördinates show respectively the hour of the day and the degree of temperature. The horizontal ordinates indicate the hours according to the marking at the top and bottom; the vertical, the temperature, as expressed on the left; on the right are marked the months, to which the several curves belong.

By tracing the curve for January, it will be seen, that the mean temperature at 1, A. M. was above 19°, and slowly descended till 7, A. M., whence it rose rapidly till 2, P. M., and from 2 till midnight descended again, rapidly between 4 and 6, the rest of the time slowly. It appears, therefore, that the maximum heat of this mean January day occurred about 2, P. M., and the minimum about 7, A. M., the range being near 12½°. The curves for the other months have the same general form. The maximum is always near 2, P. M.; but the minimum, which commonly takes place near sun-rise, varies from 4 to 8, A. M., according to the season. The heavy curve, commencing near 43° on the left, and marked "year" on the right, exhibits the mean of all the other curves; and hence represents the thermometrical changes during what may be termed *a mean annual day.* Its maximum is near 2, P. M., its minimum about 5, A. M., and its range 14°.61.

In this annual curve, the small irregularities of the monthly curves balance each other, and disappear. Its upper half is symmetrical, and has very nearly the form of a parabola. But in tracing the two branches from the vertex to the minimum point, it will be perceived that the inclinations of the lower parts are very unequal, the night portion sloping much more gradually than the morning portion. The same thing is indicated by the fact, that between the points of minimum and maximum temperature, there intervene only nine hours in the morning, but fifteen hours in the afternoon and night.

The straight horizontal line, near 47°, expresses the mean temperature of the year, and crosses the last named curve, so as to make the sum of the vertical ordinates above it equal to those below.

Another curve is introduced, which has no connection with the hours marked at top and bottom. On the *second* vertical line is placed a small mark at 22°.94, the mean temperature of January; on the *fourth*, another mark at 28°.57, the mean temperature of February, and so on. These marks are then connected by a continued curve, which therefore expresses the annual range of the monthly means. Each small mark through which the curve passes, is the place where might be drawn a horizontal line, that would be obtained from the corresponding monthly curve, by reducing its vertical ordinates to an average. The horizontal line near 47°, already noticed, bears the same relation to this as to the other annual curve; in each, the sum of the ordinates above the straight line is equal to the sum below.

An inspection of the curves, as well as of the table, shows that January was the coldest, and July the warmest month of the year, as is usually the case; that the temperature of March and November was nearly equal; also that of February and December; that the mean of the whole year differed less from that of April than any other month; and that *seven* months were warmer, while only *five* were colder than the annual mean. It is noticeable, also, that in summer the mean daily range is three or four degrees greater than in winter.

As the principal object in view was to derive a rule for obtaining the mean temperature from two or three daily observations, my attention was particularly directed to this subject. After making various combinations of the hourly means, and comparing them with the true mean, the following very simple rule was discovered. Divide the meteorological year into quarters, thus:—

1st quarter.—November, December, January.
2d quarter.—February, March, April.
3d quarter.—May, June, July.
4th quarter.—August, September, October.

The equinoxes and solstices fall about in the middle of the quarters respectively. During the first quarter, record the thermometer at 9, A. M. and 6, P. M.

2d qr. at 8, A. M. and 6, P. M.
3d qr. at 7, A. M. and 6, P. M.
4th qr. at 8, A. M. and 6, P. M.

The following table exhibits a comparison of the true averages, and those obtained from the hours just named.

	True mean.	
		9 & 6
1st qr.	29°.01	28°.90
		8 & 6
2d qr.	37°.31	37°.35
		7 & 6
3d qr.	63°.38	63°.41
		8 & 6
4th qr.	59°.23	59°.41
Whole year,	47°.23	47°.27

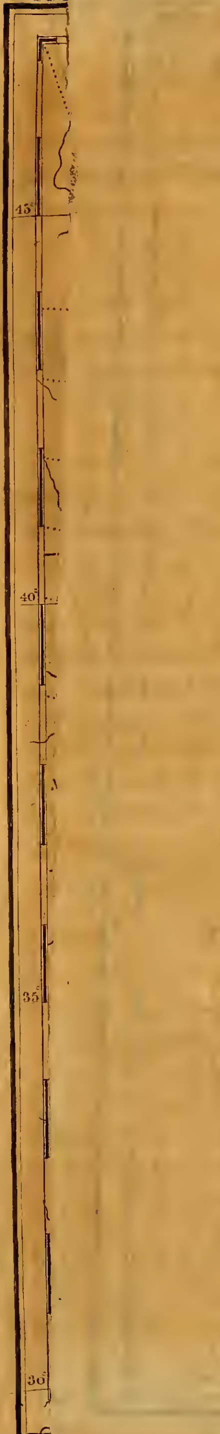
The numbers in these two columns almost perfectly coincide, and it is probable, that were the experiment to be tried in almost any other year, the agreement would be less exact. But since the annual mean temperature at a given place, as is well known, is nearly the same from year to year, and since the hours of observation in the above system have a symmetrical arrangement with regard to the sun's declination, it is believed the rule will be nearly accurate every year at this place, and at other places whose latitude does not differ widely from this. There must of course be two points of time in the mean annual day, (one in the ascent of the thermometer, the other in its descent,) at which the mean temperature occurred. They are indicated in the plate by the intersections of the annual curve, and the corresponding straight line. These intersections, which are seen to be a little after 9, A. M., and before 8, P. M., calculation fixes at 9h. 5m. A. M., and 7h. 49m. P. M. Either of these points would be the proper time for a single daily observation, for the purpose of obtaining the mean temperature of the year. In a paper in the Edinburgh Transactions, Vol. x., Dr. Brewster states the mean temperature of the years 1824 and 1825, to have occurred at 9h. 13m. A. M. and 8h. 27m. P. M., in the latitude of Edinburgh.

By the use of a maximum and minimum thermometer, I have registered the daily extremes of temperature, and the mean of those extremes. The annual average of all the daily means is 47°.38, which differs but slightly from the foregoing results. This method may undoubtedly be employed for obtaining the *annual* mean with little error; but it is not accurate for *all parts* of the year; for in winter the true mean is lower, and in summer higher, than the mean of daily extremes.

The following rule for obtaining the mean temperature is adopted in the state of New York, by direction of the Regents of the University. Observe the thermometer first, between daylight and sunrise; second, between 2 and 4, P. M.; third, an hour after sunset. Add together the first, twice the second and third, and the first of the next day, and divide the sum by six. I have applied this rule to a few months of the year, and find the results to agree pretty nearly with those which are given above; the greatest discrepancy noticed does not exceed three tenths of a degree.

That I might judge of the probable error arising from the omission of the Sabbaths, I have compared together the mean temperature at 9, A. M. and 3, P. M., taken from the meteorological journal of the college, in which the record is made every day, and the mean temperature of the same hours, exclusive of the Sabbaths. The former is 49°.81; the latter 50°.01; making a difference of one fifth of a degree. But the error arising from this source would affect to almost an equal amount both the annual mean, and the mean as deduced from the proposed system of two daily observations; so that the rule applies with nearly the same precision as if the series had been uninterrupted.

Pl. 2




MAGNETIC CHART
of the
United States
BY ELIAS LOOMIS.
1840
LAKE SUPERIOR
LAKE HURON
LAKE MICHIGAN
LAKE ONTARIO
LAKE ERIE
WISCONSIN
MICHIGAN
OHIO
PENNSYLVANIA
NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
MASSACHUSETTS
NEW JERSEY
DELAWARE
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
LOUISIANA
TENNESSEE
KENTUCKY
MISSOURI
FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
Montreal
Quebec
Toronto
Rochester
Buffalo
Albany
Portland
Portsmouth
Boston
New York
Haven
Green Bay
Chicago
Detroit
Cleveland
Harrisburg
Philadelphia
Baltimore
Washington
Fredericksburg
Richmond
Norfolk
Columbus
Indianapolis
Cincinnati
Vincennes
Louisville
Alton
Vandalia
Franklin
St. Louis
Nashville
Knoxville
Raleigh
Newbern
Columbia
Augusta
Charleston
Savannah
Milledgeville
Tuscaloosa
Florence
Lt. Rock
Natchez
Mobile
Pensacola
New Orleans
St. Augustine
Dip. 71
Dip. 73
Dip. 72
Dip. 70
Dip. 69
Ohio River
Mississippi
W. from Greenwich

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

Communicated to the Conn. Acad. of Arts and Sciences, and read April 28, 1840.

I. *Variation of the Magnetic Needle.*

In the number of this Journal for July, 1838, (Vol. xxxiv,) I have given a collection of all the observations on the variation of the magnetic needle in the United States, which I had at that time been able to collect, and from them was enabled to draw upon a chart the lines of equal variation with tolerable accuracy. The observations, however, exhibited various anomalies, and for the southern part of the country were very few in number. Further information on the subject was therefore desirable. I have accordingly sought observations from every source in my power; with what success the present article will show. The earliest information on the subject I have been able to obtain, is contained in the Journal of Hudson's third voyage, in 1609, when he discovered Hudson River. The Journal is contained in the third volume of Purchas's Pilgrims, from which the following extract was furnished me by Prof. Jared Sparks, of Cambridge. Hudson came to the Grand Bank of Newfoundland, and proceeded along the coast to the thirty-fifth degree of latitude. He does not mention his longitude, but was commonly in sight of land.

July	3,	1609.	Bank of Newfoundland.	Lat. 44°	varia.	17°w.
"	4,	"	" "	Uncertain.	"	15
"	5,	"	" "	44°10′	"	13
"	10,	"	Near Cape Sables.		"	17
"	25,	"	Mouth of Penobscot River.	44 1	"	10
"	26,	"	At Sunset.	43 56	"	10
"	28,	"	Farther S. towards Cape Cod.		"	6
"	29,	"	Sunset—near Cape Cod.		"	5½
Aug.	11,	"	Near the coast.	39 11	"	11¼
"	12,	"	At noon.	38 13	"	10
"	13,	"	At noon.	37 45	"	7½
"	15,	"		37 25	"	7
"	22,	"		about 36	"	4
Sept.	13,	"	A few miles up Hudson's River,		"	13
Oct.	4,	"	At noon—on the coast.	39 30	"	6

On the 2d of September, when he was near the Jersey shore, a little below the mouth of Hudson's River, he says: 'This night I found the land to haul the compass eight degrees. For to the northward of us we saw high hills. For the day before we found not above two degrees variation.'

Most of the preceding observations were of course made on shipboard, and perhaps all, with the exception of that of Sept. 13th. The iron of the vessel would necessarily influence the needle to an amount which we have, perhaps, no means of estimating. The observation of Sept. 13th, it is presumed, was made on shore, and may be compared with subsequent observations at New York city. The variation here in 1686, according to Mr. Welles, was 8° 45′, showing a decrease of 4° 15′ in seventy-seven years, or about three and a third minutes per year. This accords very well with subsequent observations at the same place.

Most of the other observations which I have obtained are of recent date. The Geological Reports of Maine, New York, Georgia, Ohio, and Michigan, have furnished the principal part. In September, 1839, I obtained a few observations from the General Land Office at Washington; a few are from the New York Regents' Reports, and the remainder are from miscellaneous sources. The catalogue is here subjoined; the stations being arranged by States, commencing with the most easterly.

Observations on the Variation of the Magnetic Needle in different parts of the United States.

Place.	Lat. N.	Lon. W.	Variation.	Date.	Authority.
MAINE.	° ′	° ′	° ′		
N. E. angle of State,	48 0	67 37	19 12 w	1838	State Comm'rs.
Greenville,	45 24	69 35	11 0	"	Third Geo. Report.
Farmington,	44 42	70 4	11 20	"	"
Umbagog Lake,	44 42	70 53	13 0	"	"
Dixfield,	44 32	70 14	12 0	"	"
Rumford,	44 30	70 26	11 0	"	"
Waterville,	44 28	69 32	12 8	1835	"
Belfast,	44 26	68 54	13 0	1838	"
Raymond,	43 57	70 24	9 45	"	"
West Thomaston,	43 56	69 5	12 0	"	"
NEW HAMPSHIRE.					
Hanover,	43 42	72 10	9 15	1839	Prof. Young.
VERMONT.					
Burlington,	44 27	73 10	7 36	1826	Prof. G. W. Benedict.
MASSACHUSETTS.					
Williamstown,	42 43	73 13	6 15	1833	Prof. A. Hopkins.
"	"	"	7 45	1837	" "

Place.	Lat. N.	Lon. W.	Variation.	Date.	Authority.
MASSACHUSETTS.	° ′	° ′	° ′		
Dorchester,	42 19	71 4	9 6 w	1839	Mr. Bond.
House Point Island,	42 3	70 4	9 20	1835	Gov't Survey.
Southwick,	42 4	72 46	8 15	1838	Amasa Holcomb.
RHODE ISLAND.					
Newport,	41 28	71 21	7 0	1831	James Stevens.
CONNECTICUT.					
New Haven,	41 18	72 58	6 10	1840	E. C. Herrick.
NEW YORK.					
Champlain,	45 0	73 26	9 30	1838	Geological Report.
West Chazy,	44 52	73 25	9 21	"	" "
Ogdensburg,	44 40	75 30	6 10	"	J. H. Coffin.
Keeseville,	44 28	73 32	7 30	1825	Geological Report.
"	"	"	8 40	1838	" "
Rossie,	44 22	75 43	6 43	1839	Prof. A. Hopkins.
Dial Mountain,	44 21	73 50	9 33	1838	Geological Report.
Base of Mountain,	44 21	73 48	7 8	"	" "
Cedar Point,	44 3	73 29	9 28	"	" "
East Moriah,	44 3	73 31	10 10	"	" "
Small Pond,	44 3	73 37	7 18	"	" "
West Moriah,	44 1	73 41	7 1	"	" "
Near the Mountain,	44 1	73 50	8 16	"	" "
Crown Point,	43 55	73 27	8 47	"	" "
Warrensburgh,	43 26	73 45	7 15	"	" "
Rochester,	43 8	77 51	5 4	1837	Regents' Rpt. 1839.
Cazenovia,	42 55	75 51	4 0	"	" "
Hamilton,	42 49	75 34	4 30	"	" "
Troy,	42 44	73 40	6 4	1827	Am. Jour. v. 17, p. 198.
Albany,	42 39	73 45	6 14	1828	Regents' Rpt. 1829.
"	"	"	6 18	1830	" " 1831.
"	"	"	6 32	1831	" " 1832.
Oxford,	42 28	75 33	4 30	1837	" " 1839.
Guilford,	42 23	75 26	4 30	1838	" "
Flatbush,	40 37	73 58	4 45	1837	" "
"	"	"	4 45	1838	" "
PENNSYLVANIA.					
Fairview,	42 5	80 27	0 0	"	H. H. Sherwood.
MARYLAND.					
Baltimore,	39 17	76 37	12 w	1808	Am. Jour. v. 18, p. 381.
GEORGIA.					
Toccoa Falls, Habersham Co.			5 0 E	1837	Geological Survey.
Summit of Toccoa Mt.			5 0	"	" "
Tellulah River, Habersham Co.			4 44	"	" "
Carnesville,	34 25	83 25	5 1	"	" "
Thornville, Elbert Co.			4 33	"	" "
Elberton,	34 6	82 59	4 33	"	" "
Lawrenceville,	33 58	84 10	5 0	1839	" "
Goshen,	33 52	82 40	5 9	1837	" "

Place.	Lat. N.	Lon. W.	Variation.	Date.	Authority.
GEORGIA.	° ′	° ′	° ′		
Monroe,	33 51	83 53	5 10 E	1838	Geological Survey.
Berlin, Richmond Co.			5 4	1837	" "
Lincolnton,	33 46	82 38	5 9	"	" "
Madison,	33 34	83 40	4 29	1838	" "
Applington,	33 32	82 27	5 0	1837	" "
Augusta,	33 26	82 1	5 4	"	" "
Eatonton,	33 21	83 34	4 32	1838	" "
Milledgeville,	33 7	83 20	5 51	"	" "
Waynesboro',	33 3	82 9	5 4	1837	" "
Saundersville,	32 57	82 59	5 27	1838	" "
Mill Haven,	32 56	81 47	5 4	1837	" "
Black Creek, Scriven Co.			5 4	"	" "
Wendover, Scriven co.			4 55	"	" "
Edward J. Black's house, Scriven Co.			5 3	"	" "
Jacksonboro',	32 49	81 43	4 55	"	" "
Birdsville,	32 48	82 13	5 1	"	" "
Swainsboro',	32 39	82 30	5 4	1838	" "
Columbus,	32 28	85 10	5 30	1839	" "
Springfield,	32 21	81 30	5 5	1837	" "
Oak Level, Effingham Co.			5 5	"	" "
Ashville, Effingham Co.			5 5	"	" "
Cottage Green, Effingham Co.			5 5	"	" "
Baird's Creek, Tatnall Co.			5 23	1838	" "
Lumpkin,	32 9	84 55	5 27	1839	" "
Savannah,	32 5	81 7	5 5	1838	" "
"	"	"	3 31	1839	Dr. Posey.
Bryan C. H.	32 2	81 32	5 5	1838	Geological Survey.
Cuthbert,	31 49	85 2	5 30	1839	" "
Liberty C. H.	31 48	81 37	5 5	1838	" "
Fort Gaines,	31 38	85 19	5 31	1839	" "
Darien,	31 26	81 37	5 5	1838	" "
Bainbridge,	30 55	84 46	5 30	1839	" "
ALABAMA.					
Tuscaloosa,	33 12	87 42	7 28	"	Prof. Barnard.
LOUISIANA.					
	32 50	92 22	8 40	1835	Public Surveys.
	32 25	92 32	9 10	1813	" "
	"	"	8 30	1836	" "
	31 50	92 32	8 30	1834	" "
	31 45	92 22	8 30	"	" "
	31 40	92 32	8 40	1835	" "
Mouth of Sabine river,	29 41	94 0	8 41	1840	Boundary Comm'rs

Place.	Lat. N.	Lon. W.	Variation.	Date.	Authority.
OHIO.	° ′	° ′	° ′		
Chardon,	41 35	81 15	15 E	1838	R. Cowles.
Euclid,	41 34	81 32	1 30	1825	Ahaz Merchant.
Cleveland,	41 30	81 46	1 20	1830	" "
"	"	"	50	1834	" "
"	"	"	35	1838	" "
Lower Sandusky,	41 21	83 9	2 48	"	David Reeves.
Flat Rock,	41 18	84 12	3 14	"	Wm. C. Brownell.
Hudson,	41 15	81 26	54	1839	Prof. Loomis.
"	"	"	52	1840	" "
Brookfield,	41 14	80 37	40	1837	George Boyce.
Braceville,	41 14	81 3	50	1838	Franklin E. Stowe.
Tallmadge,	41 5	81 26	1 0	1806	S. E. Ensign.
Portage,	41 0	81 31	1 0	1797	Moses Warren.
"	"	"	1 15	1838	Mr. Mallison.
Kalida,	40 59	84 14	3 0	"	E. B. Fitch.
Wooster,	40 49	81 58	2 33	1831	C. W. Christmas.
"	"	"	1 47	1837	" "
"	"	"	1 57	1839	" "
"	"	"	1 47	1840	" "
Kenton,	40 39	83 37	5 17	1838	John H. Ross.
Sandy,	40 37	81 28	2 10	1810	E. Buckingham.
Carrolton,	40 36	81 9	30	1838	Van Brown.
Marion,	40 35	83 9	3 17	"	Samuel Holmes.
Dover,	40 31	81 29	1 50	"	Herman V. Beeson.
Coshocton,	40 28	81 57	1 30	"	John W. Sweeny.
St. Clairsville,	40 10	80 52	3 10	1820	James C. Moore.
"	"	"	2 32	1837	" "
"	"	"	2 31	1838	" "
Zanesville,	39 58	82 4	2 30	"	James Boyle.
Batesville,	39 58	81 11	1 22	"	M. Atkinson.
New Madison,	39 56	84 37	5 23	1826	Judson Jaqua.
"	"	"	4 51	1838	" "
Springfield,	39 54	83 47	4 30	1835	Public Survey.
Spring Bank,	39 45		4 54	1818	Moses Collier.
"	"	"	3 14	1838	" "
Washington,	39 34	83 21	3 6	"	Joseph Bell.
Springboro',	39 31	84 16	5 30	1820	E. Baily.
"	"	"	4 4	1838	" "
Near Marietta,	39 31	81 26	1 36	"	B. E. Stone.
Wilmington,	39 28	83 42	4 25	1834	David Wickersham.
"	"	"	4 5	1838	" "
Chillicothe,	39 21	82 54	3 15	1835	A. Bourne.
Athens,	39 16	81 5	4 3	1796	Public Surveys.
"	"	"	3 12	1838	S. B. Pruden.
Jackson,	39 15	82 42	3 10	"	Oliver N. Tyson.
Cincinnati,	39 6	84 27	4 58	1806	Public Surveys.
Gallipolis,	38 53	82 7	3 40	"	Joseph Fletcher.
"	"	"	2 35	1838	" "

Place.	Lat. N.	Lon. W.	Variation.	Date.	Authority.
INDIANA.	° ′	° ′	° ′		
Logansport,	40 45	86 24	5 35 E.	1836	Town plan.
ILLINOIS.					
	41 15	88 32	8 15	1821	Public Surveys.
	41 10	"	8 0	"	"
	"	"	7 25	1838	"
	41 0	"	6 50	"	"
	40 50	"	7 43	1833	"
	40 30	"	7 30	1823	"
	40 20	"	7 40	"	"
	40 0	"	7 55	1822	"
	39 30	"	8 0	1821	"
Alton,	38 52	90 12	7 45	1840	H. Loomis.
	38 30	88 32	7 50	1818	Public Surveys.
MISSOURI.					
	37 30	90 2	7 30	1827	"
	37 0	"	8 0	1823	"
	"	90 12	8 0	"	"
	36 50	90 2	7 30	"	"
	36 40	"	8 0	1825	"
MICHIGAN.					
Machinac,	45 51	84 31	2 59	1827	Lucius Lyon.
Michigan shore,	44 31	85 32	4 30	1838	Geolog. Report.
	"	84 56	2 50	"	"
	"	84 28	2 45	"	"
	"	83 50	2 0	"	"
Pointe aux Barques,	43 51	82 42	1 38	1835	"
Twenty miles west,	"	83 6	2 6	"	"
	43 45	84 22	2 55	1832	Public Surveys.
Pere Marquette river,	43 44	85 43	4 34	1837	Geolog. Report.
Saginaw river,	43 36	83 50	2 19	1835	"
Little Pointe aux Sables,	43 31	85 54	6 0	1837	"
	43 20	84 22	3 0	1832	Public Surveys.
	43 19	85 59	6 15	1837	Geolog. Report.
Shore of Lake Huron,	43 5	82 26	6	1835	"
	43 0	84 22	3 27	1831	Public Surveys.
Grand River,	42 55	86 10	$3\frac{3}{4}$° to 6°	1825	Lucius Lyon.
"	"	"	4° 30′	1837	Geolog. Report.
	42 50	84 22	4 55	1826	Public Surveys.
	42 30	84 22	4 25	"	"
Detroit,	42 24	82 58	3 13	1822	Lucius Lyon.
"	"	"	2 50	1828	"
"	"	"	2 10	1835	Geolog. Report.
"	"	"	2 0	1840	"

As some of the stations for Georgia are not to be found on Mitchell's map, their latitudes and longitudes could not be given. The name of the county however indicates nearly their position.

The general conclusions at which I arrived in my former paper, are abundantly confirmed by the preceding observations. They all indicate a retrograde motion of the needle, which commenced every where as early as 1819, and in some places perhaps as early as 1793. The present annual change of variation is about two minutes for the southern states; four minutes for the middle and western states; and six minutes for the New England states.

The observations of variation contained in my present and former catalogues were now all reduced to the year 1840, by applying a correction for the annual motion, and the lines of equal variation laid down upon the accompanying chart so as best to represent the observations. It is believed that the errors of the chart as thus corrected must be quite small. In my former paper, I noticed three observations which exhibited a remarkable discordance with the rest. They were for Hanover, N. H., Montpelier, Vt., and Princeton, N. J. It is gratifying to find that the present variation at the former place, as observed by Prof. Young, agrees almost exactly with my chart. It is believed that the observations at the other two places will be found to be erroneous, or that they were affected by very strong local attraction.

It seems almost superfluous to remark, that most of the observations in the preceding table were evidently made with inferior instruments, and can lay but a moderate claim to accuracy. A large part of the observations are clearly erroneous to the amount of half a degree; and the errors of many exceed one degree. As most of the errors however are such as may be expected to disappear in taking a mean, considerable confidence is placed in the position of the lines of equal variation as projected on the accompanying chart. To attain materially greater accuracy, observations must be made with better instruments and by more skillful observers.

II. *Dip of the Magnetic Needle.*

The chief additional observations of the magnetic dip which I have been able to obtain, were made by Prof. Locke and myself. The former were communicated to me by letter; the latter are given at large in volume seventh (N. S.) of the Transactions of the American Philosophical Society.

Places.	Lat. N.		Lon. W.		Dip.		Date.	Authority.
	°	′	°	′	°	′		
Montreal, L. C.	45	31	73	25	77	6	1833	Capt. Back.
Halifax, N. S.	44	39	63	37	75	53	1834	Capt. Horne.
" "	44	39	63	37	74	58	1837	"
Oswego, N. Y.	43	26	76	36	75	11.3	1839	Prof. Loomis.
Utica, N. Y.	43	7	75	13	74	57.2	"	"
Prairie du Chien, W. T.	43	3	91	6	73	16.8	"	Prof. Locke.
Madison, W. T.	43	1	89	38	74	4.4	"	"
Syracuse, N. Y.	43	0	76	14	74	50.9	"	Prof. Loomis.
Buffalo, N. Y.	42	53	78	55	74	40.8	"	"
Mineral Point, W. T.	42	50	89	54	73	20.6	"	Prof. Locke.
Schenectada, N. Y.	42	48	73	55	74	36.1	"	Prof. Loomis.
Albany, N. Y.	42	39	73	45	74	51.3	"	"
Dubuque, Iowa,	42	29	90	30	73	5	"	Prof. Locke.
Cambridge, Mass.	42	22	71	8	74	20.1	"	Prof. Loomis.
Detroit, Mich.	42	19	83	2	73	42.6	"	"
Dorchester, Mass.	42	19	71	4	74	19	"	Mr. Bond.
Ann Arbor, Mich.	42	18	83	44	73	13.9	"	Prof. Loomis.
Worcester, Mass.	42	16	71	48	74	20.6	"	"
Ypsilanti, Mich.	42	14	83	37	73	18.0	"	"
Springfield, Mass.	42	6	72	36	74	6.9	"	"
———, Iowa,	42	4	91	2	72	24.4	"	Prof. Locke.
Longmeadow, Mass.	42	2	72	36	74	5.3	"	Prof. Loomis.
Monroe, Mich.	41	55	83	27	73	32.3	"	"
Providence, R. I.	41	50	71	25	73	59.6	"	"
Hartford, Conn.	41	46	72	41	73	58.1	"	"
Toledo, Ohio,	41	41	83	32	73	6.1	"	"
Maumee, Ohio,	41	34	83	37	72	49.1	"	"
Cleveland, Ohio,	41	30	81	51	73	26.0	"	"
Sandusky, Ohio,	41	29	82	47	72	57.8	"	"
Davenport, Rock Isl'nd,	41	28	90	41	71	55	"	Prof. Locke.
West Point, N. Y.	41	25	74	0	73	27.4	"	Prof. Loomis.
New Haven, Conn.	41	18	72	58	73	26.7	"	"
Hudson, Ohio,	41	15	81	26	72	48.2	1838	"
" "	41	15	81	26	72	47.3	1839	"
" "	41	15	81	26	72	53.9	1840	"
Beaver, Penn.	40	44	80	27	72	40.3	1839	"
New York City,	40	43	74	1	72	52.2	"	"
Pittsburgh, Penn.	40	32	80	2	72	38.9	"	"
Princeton, N. J.	40	22	74	40	72	47.1	"	"
Philadelphia, Penn.	39	57	75	11	71	43.9	1838	Pres. Bache.
" "	39	57	75	11	72	7.1	1839	Prof. Loomis.
Baltimore, Md.	39	17	76	37	71	50.3	"	"
Cincinnati, Ohio,	39	6	84	27	70	27	1840	Prof. Locke.
Washington City,	38	53	77	1	71	13	1838	Lieut. Wilkes.
" "	38	53	77	1	71	21.4	1839	Prof. Loomis.
St. Louis, Mo.	38	37	90	16	69	31.4	"	Prof. Locke.
Louisville, Ky.	38	18	85	46	70	8	"	"
" "	38	18	85	46	69	56	1840	"
Bermuda,	32	34	63	28	67	45	1834	Capt. Horne.
"	32	34	63	28	67	18	1836	"

In order to determine what changes the dip is undergoing, I first drew upon a chart lines representing the recent observations, and from these determined the dip at each of the stations where observations were made in Long's Expedition, and which are given in my former paper. The mean difference is 30′. In the absence then of more accurate data, we may call this the diminution of the dip from 1819 to 1839, being at the rate of 1.′5 per year.

The observations at New York also indicate a diminution since 1822, but being made with different instruments, and by different individuals, they are scarcely comparable. In order however to arrive at the most satisfactory result, let us take the mean of the observations by Capt. Sabine and Sir John Franklin, contained in my former paper, which gives us 73° 16′, corresponding to 1823.5. Taking also the mean of the observations by Capt. Back, Prof. Bache and myself, we have 72° 51′ corresponding to 1835.3. The difference is 25′ for 11.8 years, indicating a diminution of 2.′1 per year. The mean between this and the former determination is 1.′8, which I assume to be the annual diminution of dip for the United States. The observations contained in this and my former paper were now all reduced to the year 1840, by applying the annual variation, and the lines of equal dip drawn upon the accompanying chart. Among the thirty observations by myself, nine appear to be in error to the amount of at least 10′. They are as follows:

Ann Arbor,	error −19′	Ypsilanti,	error −15
Pittsburgh,	+17	Monroe,	+13
Cleveland,	+16	Schenectada,	−11
Baltimore,	+16	Princeton,	+11
Albany,	+15		

The lines of equal dip were first drawn upon a large and accurate map of the United States, and from this were copied upon the accompanying chart. The errors here mentioned were measured upon the original map, and not upon the accompanying chart, on which the position of several places is marked erroneously.

The above differences are to be ascribed to local attraction, and errors of observation. Errors of this kind are unavoidable. The magnetic survey of Scotland, by Major Sabine, exhibits a greater number of errors of this magnitude, and the sum of the errors is also greater.

Four of the observations of Prof. Locke exhibit errors greater than 10′. They are

Madison	+27′	Prairie du Chien	−20′
Columbus	−23	Louisville	+12.

The observation at Charlottesville exhibits an error of +26′; and that at Baltimore by Prof. Courtenay −44′. This is by far the greatest error of all the observations, if we except that made at Pittsburgh in 1819. The observation was made in the middle of the city, and it may be presumed that the needle was subjected to strong local attraction. In my former paper, I noticed the Pittsburgh observation as being specially anomalous. My own observations show that there was here an error from some source of about five degrees.

It is believed that the accompanying chart will be found to represent the lines of equal dip for the northern part of the United States with a good degree of accuracy. For the southern states they could only be drawn conjecturally, as I know of no observations of dip made in this country south of the parallel of thirty eight degrees.

Art. VI.—*Caricography;* by Prof. C. Dewey.

(Appendix, continued from Vol. xxx, p. 64.)

Since the last number of the Caricography, only a few additions have been made to the Carices of North America. An elaborate monograph of the Cyperaceæ of our country by Professor Torrey, was published in the Annals of the Lyceum of New York in 1836, which contained a list of our known Carices, with the additions which his extensive correspondence and facilities had made to them, and such corrections as were judged necessary from a more full acquaintance with this extensive genus. In a future paper, a new arrangement of the species may be given, which shall embrace all the later discovered species and some corrections. In this paper it is proposed to continue the history of the species which have been found in the United States, that the few later discoveries may be generally known. After all the ardor with which Carices have been sought, and the multitude found, it is wonderful that any have remained to be detected. Those species described by the early examiners of our country, have nearly all been ascertained, offering strong presumption that all of them will yet be found and identified.

No. 169. Carex *capitata*, L.
Schk. Tab. Y. fig. 80.
Wahl. No. 2, and Willd.
Monograph. Cyp. Torrey, p. 387.

Unispicata simplici androgyna; spica supernè staminifera subglobosa *distigmatica;* fructibus densis ovato-rotundis compressis convexo-concavis perglabris subacutis, squama ovato-obtusa longioribus; foliis filiformibus.

"Culm three to seven inches high, grows in tufts," *Robbins;* triangular, rather scabrous, terminated with a single globose spike of pistillate flowers, and with the stamens on a slight prolongation of the upper part, as depicted by Schkuhr; leaves slender, rising from sheaths towards the base; pistillate scale roundish ovate, obtusish, more than half the length of the fruit.

Wahlenberg credited this species only to the mountains of Lapland. It has since been found across Northern America to the Rocky Mountains. *Torrey.* In 1829 it was found by Dr. Robbins on the Alpine region of the White Mountains of New Hampshire, and Mr. Oakes of Ipswich, Mass., has been so good as to forward it for publication.

No. 170. C. *tenuiflora*, Wahl. No. 48.
Schk. Tab. Eeee. fig. 187.
Mon. Cyp. Torrey, p. 392.

Spica composita; spiculis alternis binis vel ternis approximatis ovatis, inferne staminiferis; fructibus *distigmaticis* ovatis oblongis subacutis convexo-planis, squamam oblongo-ovatam acutiusculam æquantibus.

Culm about a foot long, "in small tufts, and prostrate," (Robbins,) triangular, slightly scabrous, slender, leafy towards the base; leaves narrow, flattish, linear, shorter than the culm; belongs in the subdivision with C. *curta*, Gooden.

Wahlenberg credited this species to the moist grassy fields of Lapland. The late indefatigable explorers of Arctic America found it. In 1829 it was found by Dr. Robbins, both in a sphagnous swamp in Burlington, Vt., and in wet places with C. *disperma*, D. in Salem, Vt. Communicated with the following by Mr. Oakes.

No. 171. C. *capillaris*, L.
Schk. Tab. O. fig. 56. Wahl. No. 91.
Mon. Cyp. Tor. p. 416.

Spicis distinctis; spica staminifera solitaria parva; spicis fructiferis *tristigmaticis* subternis oblongis paucifloris laxifloris longipedunculatis recurvatis; fructibus ovalibus brevirostratis oblongis ore obliquis, squama ovata oblonga obtusa longioribus.

"Grows in tufts from two seven inches high," Robbins; culm roundish, smooth, quite leafy towards the base, and having a leafy bract under the spikes; leaves narrow, long as the culm; fertile spikes on exsert recurved peduncles, with a few rather loose flowers, and having the fruit oblong, oval, acutish, somewhat beaked, and longer than the oblong or ovate and obtuse scale.

Schkuhr credits this species to most of Europe. It has been found in arctic America to the Rocky Mountains. *Torrey.* It was found in 1829 by Dr. Robbins, in the alpine region of the White Mountains of New Hampshire.

Note. Dr. Robbins designed these three species to appear in the contemplated *Flora of New England*, by Wm. Oakes, Esq., of Ipswich, Mass., a work which it is much to be regretted may not soon appear.

No. 172. C. *rostrata*, Mx.

C. *xanthophysa*, Wahl. var. *nana* et *minor*, D.

C. *folliculata*. Mon. Cyp. Tor. p. 419.

Spicis distinctis; staminifera brevi solitaria sessili; pistilliferis duabus vel ternis axillaribus subglobosis flavescentibus superiore sessili, inferiore subsessili; fructibus in capite aggregatis erectis et subdivergentibus oblongo-conicis longissime rostratis, squama ovato-oblonga subacuta duplo longioribus.

Culm about a foot high, few leafed, a long bract under the lowest spike, erect, stiff, with two or sometimes three sessile or nearly sessile pistillate spikes of a globular or capitate form, fruit small, conic, very long beaked, little inflated at the base; pistillate scale ovate, oblong, obtusish, not half the length of the fruit. Grows at the base of the White Mountains.—*Oakes.* Also in Canada or the northern regions.

Dr. Torrey has ascertained by an examination of the plants collected by Michaux, that his plant is *the dwarf variety*, as it has been called, of C. *xanthophysa*, Wahl. This I had supposed the truth; but a comparison of the specimens found by Mr. Oakes on the White Mountains, with others from Canada, and with the description of Michaux, has led me to conclude that the plant of Mich. is wholly distinct. It is so constant in its character that I had already described it as a fixed variety, in Vol. xiv, p. 353, of this Journal, and given a figure of it in Tab. D, fig. 15, of the same volume. It is not the variety of C. *tentaculata*, which Mich. called C. *rostrata* in letters to Schk., as these are obviously the same, for both are in my herbarium.

C. *rostrata*, Mich., is a more stiff and less leafy plant than C. *xanthophysa*, Wahl., and has sessile spikes, while the other has them on long exsert peduncles and recurved, and with stamens at the apex as Mich. remarked; and it has a short, hardly acute pistillate scale, while the other has an ovate, acuminate, and long cuspidate scale but little shorter than the fruit. There can be no doubt that the C. *rostrata*, Mich. is identified, and is a distinct species.

Art. VII.—*Notice of the Tooth of a Mastodon;* by Jeffries Wyman, M. D.

The specimen from which the following description is drawn, was deposited in the cabinet of the Boston Society of Natural History, by the Rev. Howard Malcom, by whom it was obtained at a place called Yea-nan-goung, situated on the banks of the Irawady river, below Ava in Burmah. It consists of a fragment of the left lower jaw of a mastodon, containing one molar tooth entire, excepting so much as has been worn away by the process of mastication. As it differs materially from any of which a description has been met with, it was thought worthy of a brief notice.

The jaw is broken at the two ends of the tooth, the intervening portion being entire. The whole specimen is sixteen inches in length, and its circumference around the largest part two feet two inches. The tooth measures twelve and a half inches in length and four and a half in breadth. At the anterior extremity is a portion of a denticule, of which the greater part has been ground off; allowing that this had the same dimensions with that which succeeded it, we shall have an additional length to the tooth of an inch and a half, making the entire length one foot two inches. The enamel is a quarter of an inch in thickness, and its surface is rough from an incrustation of calcareous matter. The denticules are *eight* in number, or *nine* counting the one of which only a small portion remains, and project two and a half inches above the alveoli. Each denticule uniformly consists of *four* distinct mammillary points, symmetrically arranged. These are all separated from each other by a distinct sulcus, the external ones being broad and stout at their base, and the central narrow, and laterally compressed. They diminish somewhat in size from before backwards, but the points remain uniformly four in number. The first four denticules have suffered more or less from attrition, the remaining ones being unimpaired.

The only description which I have been able to find, corresponding in any degree with the above, is that of the Mastodon *elephantoides*, described and figured* by Mr. Clift. This was also brought from the valley of the Irawady river several years since. "The tooth was eleven inches long and three and a half broad, has no less than *ten* denticules, each of which is mammillated with small points, *five* being the smallest and *eight* the largest number in any one denticule." It is obvious from the figure which accompanies his description that the tooth was entire, as the points of the denticules were but very slightly worn. He further adds, "the denticules of the tooth are more compressed than in the M. *latidens*. They form a series of *plates* mucronated with small points. There is no apparent commissure nor any central depression."

Comparing the two descriptions, it will be seen at once that they differ materially in regard to the number of points composing each of the denticules, those of the M. *elephantoides*, having from five to eight, while those of the other are uniformly four. The points of the former are very closely approximated, leaving but a very slight depression between them, while those of the latter are quite distinct. The question, how far are these differences to be attributed to difference in age, presents itself. Now it is well known that each successive tooth is larger than that which preceded it, and the number of denticules in the same species is in proportion to the size of the tooth. If however the two specimens which we have noticed were the same, that which is largest would be provided with the greatest number of denticules, which is not the case, they being actually less in number.

Mr. Clift considers the Mastodon *elephantoides* as an intermediate link between the genus Mastodon and Elephas. Should the specimen here noticed prove to be a new species, it would serve to fill up another gap in the transition from one of these genera to the other.

Boston, May 2d, 1840.

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* Vide Trans. Geolog. Soc. London, Vol. VII, p. 372.

Art. VIII.—*Infinite Divisibility of Matter.**

(Communicated for this Journal.)

The arguments which favor the doctrine of the infinite divisibility of matter are derived from the wonderful extent to which subdivision has been carried in actual experiment, and from the supposition that if a magnitude however small may be assigned or imagined, a fractional part of it may also be assigned or imagined. As there appears at present little probability that the negative of this question will soon be established by experiment, the result of which heretofore seems rather to favor the reverse, if it were possible to arrive at a satisfactory theoretical conclusion, though the result might not be of any practical importance, something would be gained on the side of truth.

The writer must however deprecate the charge of presumption which might attach to any attempt to decide on a point which has been the cause of so much agitation in the world of transcendental philosophy—a question which all the metaphysical talent of Germany has not been able to determine, and on which the physical researches of English inquirers have only enabled them to form a surmise.

The primary error appears to have arisen from the gratuitous assumption that divisibility is a universal property of extension, in whatever magnitude it may occur. This, as may hereafter be shown, amounts to nothing less than begging the question. But for his adherence to this opinion the German Euler would have set the matter at rest long ago; and Dugald Stewart considered a perception of the truth of infinite divisibility as almost intuitive.

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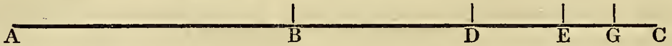
* Philadelphia, Feb. 19, 1840.

To the Editors.—Seeing in the abstract of the proceedings of the British Association for the Advancement of Science given in the last number of your Journal, some remarks by Prof. Whewell on the infinite divisibility of matter, in which he adheres to the old geometrical opinion, if I may so call it in opposition to that of modern chemists, I have ventured to offer a few words on the subject, notwithstanding the notice on the back of your Journal, that every paper shall be accompanied by the name of the author. This, peculiar circumstances prevent me from giving; and I am persuaded that should you deem these remarks worthy of an insertion, they will not be rendered the more forcible by the name of a subscriber and constant reader of your Journal.

Let us now suppose a body A to be projected from a point A in any direction with a given velocity, and another body B pro-



jected at the same instant from the point B in the same direction but some distance in advance of A and having just half its velocity. It is evident to common sense that the body A will overtake the body B at the point C equally distant from B that B is from A. But apply the law of infinite divisibility and we have a different result; for while the body A moves to the point B, the body B moves to the point D; and while A moves from B to D, B moves from D to E; and while A moves from D to E, B moves from E to G; and so on, halving to infinity, in which case it is clear the body A could never overtake the body B though moving with double its velocity. The fallacy then, consists in attempting to number the terms of an imaginary infinite series which are of course innumerable; and yet, because it is a decreasing series, these terms have a sum and a termination; viz. in the point C.

As the basis for an argument it will readily be granted,

1st. That the sum of an infinite number of magnitudes, however small, is a magnitude infinitely great;

2d. If a body of matter or any other magnitude be divided and subdivided to any extent whatever, each of the parts thus produced is itself a quantity; that is, it is greater than nothing; and

3d. That all these parts together, however numerous, exactly make up the original magnitude; or in other words "the whole is equal to the sum of all its parts."

In the case of an infinite division, as in every other, each part *a* of any finite quantity A, possesses magnitude or it could clearly be no part. As the whole is equal to the sum of all its parts, A must be equal to an infinite number of its parts *a*. But it has been granted that the sum of an infinite number of magnitudes, however small, is a magnitude infinitely great. The finite quantity A is therefore equal to an infinite quantity, which is impossible.

From the foregoing remarks it appears a legitimate conclusion, that an infinite division of a finite quantity can result in nothing short of its entire annihilation; as in the case of the bodies A and B where the distance between them becomes nothing. And further, that no finite quantity can contain an infinite number of parts however small, and of course that matter is composed of parts or atoms beyond which there can be no subdivision.

Euler made use of a similar argument to establish the reverse of these results, but his premises were unsound. He says, "whoever is disposed to deny this property of extension, (infinite divisibility,) is under the necessity of maintaining that it is possible to arrive at last to parts so minute as to be unsusceptible of any further division, *because they cease to have extension.* Nevertheless, all these particles taken together must reproduce the whole by the division of which you acquired them, and as the quantity of each would be nothing or cipher 0, a combination of ciphers would produce quantity, which is manifestly absurd." Here the *petitio principii* is easily perceptible, for he assumes that because there are "parts so minute as to be unsusceptible of any further division," therefore the "quantity of each would be nothing or cipher."

These observations may contain nothing new; the arguments may have been advanced by the followers of Wolff, who lost themselves in a labyrinth of monads; if it be so the writer having never met with them may have been only repeating that which has appealed to his own understanding with the force of mathematical demonstration.

Remarks by a Coadjutor.

In the accompanying article, the writer makes two attempts to disprove the infinite divisibility of matter. He first undertakes to point out a case in which the supposition of infinite divisibility, as a property of extension, involves an absurdity. The case may be stated thus.

Let two bodies, A and B, begin at the same time to move along the right line ABC, from A and B towards C; let the distances from A to B, and from B to C, be each one mile; and let the velocity of A be two miles a minute, and that of B, half as great. It is evident that at the end of a minute, A will overtake B, at the point C. But it is said that while A moves from A to B, B moves to D, a point midway between B and C; and while A moves from B to D, B moves from D to E; and so on, *ad infinitum;* and it is hence inferred, that A can never overtake B, though moving with twice its velocity. But this is to lose sight of the fact, that the period from the commencement of motion, to the time when either of the bodies occupies the position of any point of division whatever, in the line BC, is less than a minute; since at the end of a minute, both bodies must have arrived at C. All that can be determined by the above mode of viewing the case in question, is this; that A cannot overtake B in any time less than a minute. But the object was to prove that A can *never* overtake B; a proposition widely different from the former.

An attempt is made in the latter part of the article, to give a *general* demonstration against the infinite divisibility of matter. The proof rests on three assumptions, to which it is supposed that no objection can be made. The *first* is the proposition, that the sum of an infinite number of magnitudes, however small, is a magnitude infinitely great. This is far from being an admitted truth. Nothing is more common in mathematics than series having an infinite number of terms, and only a *finite* sum, though some of the terms are themselves of finite value. As the assumption in question is therefore groundless, it vitiates the subsequent reasoning in the article, and the result obtained by means of it must be inconclusive.

Those who maintain that bodies or portions of space are capable of infinite division, regard the parts obtained by this division, as infinitely small; and they have no difficulty in supposing that the sum of an infinite number of such parts may be only a finite quantity, the very quantity by the repeated divisions of which those parts were obtained. Hardly any thing can be more certain than that matter is infinitely divisible in the sense in which the writer of the article attempts to prove that it is not so. But there is a sense in which the infinite divisibility of matter is questionable. The inquiry concerned in it, however, is one which seems not to lie within the range of finite, or at least of the human faculties.

Art. IX.—*Formation and dispersion of a Thunder Shower—Parhelia, and Meteorological Register;* by Willis Gaylord.

To the Editors.—*Gentlemen,*—In looking over my meteorological notes for 1839, under date of August 21st I observed the following:—"Witnessed the formation and dispersion of a thunder shower, attended with some remarkable phenomena;" and as the formation and action of clouds and storms is always an object of interest, I have thought a description of the one alluded to might not be altogether without its claims to notice.

The wind on the 21st and for two days previous had been southwardly, most of the time S. E. The 20th was one of the warmest days of the season, the thermometer at 2 o'clock being at 90°, and on the 21st the mercury at 9 o'clock was 73°, and at 2 o'clock at 80°. Although the lower current of air was south, the upper did not seem to follow the same course, but was more from S. of W. This was shown by the course of some electric clouds on the 20th, and of one on the forenoon of the 21st. A little after 2 o'clock on the 21st I observed a large mass of cumulus in the S. E., not at a great distance, and with little apparent elevation. An electric cloud which was passing lay low in the horizon at the S., but between the two there was no connection; the mass of cumulus was completely isolated, a line of blue sky being distinctly visible between the two; nor was there any appearance of stratus, or the cirri, which invariably accompanies an electric cloud. There was no perceptible wind from any quarter.

I was in my garden some ten or twenty minutes after making the above observations, and not far from 3 o'clock, when my attention was arrested by a heavy roaring in the direction of the cloud, like that which accompanies a fall of hail or violent wind, and looking at the cloud, I perceived that a mass of cirri was streaming from the summit of the mass, and stretching upwards and N. E. from its highest point. There was little appearance of stratus at this time, and not the slightest indication could be discovered that rain or hail was falling from the cloud. I carefully examined the cloud to detect any motion which might exist in it, but not the least movement was perceptible, except that in a few minutes the stratus began to form rapidly at the base of the cloud, and a visible prolongation and elevation of the cirri was taking place. In a short time rain could be discovered precipitated from the cloud, and the roaring noise continued without interruption, exhibiting a singular contrast to the quiet and immovable state of the cloud. At this time the cloud was about three miles distant, and the angle of elevation shows its height to have been about six hundred feet.

The general movement of the cloud, it was soon apparent, was to the N. W., and in about twenty minutes after the first indications of a shower, I was driven within doors by a fall of the largest drops of rain I think I have ever seen. They were not numerous, but in falling seemed as large as cherries, and dashed upon the earth with the seeming force of a hailstone. No hail was observed by me, but the size of the drops excited general notice. A heavy shower of perhaps ten minutes followed these drops, but during the whole, though the roaring noise continued unabated, not the slightest wind in any direction could be felt, but the water poured down perpendicularly like a cataract. This was particularly observable when the shower had passed so that the line of fall was about one hundred rods to the west of us. While it was a blue sky over head, at that distance from us for ten minutes the water was pouring down in a vast sheet, and one mile west of us more water fell than during any other shower of the season. Before the shower had become perpendicular to us, or perhaps twenty minutes after the first rain fell from the cloud, thunder was heard in it; and after it passed, several electric explosions occurred. About five miles to the N. W. it ceased to rain, and the cloud rapidly melted away; and in two hours from its commencement nothing was to be seen of it except the train of cirri, resembling a streak of white smoke high up the sky.

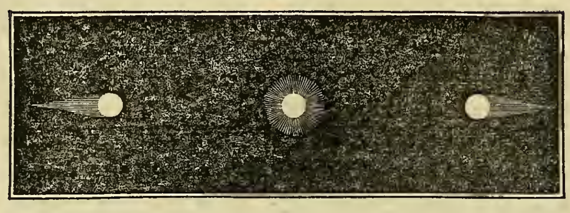
But the most singular part of this electric shower remains to be noticed. During the time of its passage, on the eastern margin of the cloud, about two miles northeast of us, little rain fell, but *hail and snow* were both precipitated from the atmosphere. On the west side of the cloud the thermometer was but little affected, not more than is usually the case in summer showers; on the eastern or northeastern side, the cold was perceptible, and the thermometer fell rapidly; but in neither case was there any apparent atmospheric movement to account for such a change. I may remark here, that while the cloud remained stationary just west of us, it was rapidly extended to the south more than a mile, giving a heavy fall of rain to its extreme limit.

I have no particular theory to support or promulgate in giving you the foregoing. One of two things is perfectly clear from the facts as observed by me. The first is, that there was no *visible* rotary movement in the cloud at any time; and the second is, that there was no rush of *surface air* to the cloud, which would seem necessary had the noise been occasioned by an internal or central whirl. I have never known a thunder shower in which such a perfect stillness of the whole atmosphere was observable as during the continuance of this. Still some such movement as this seems necessary to account, not only for the noise that attended the cloud, but also for the rapid elongation of the cirri, and the formation of the hail and snow. It would seem that by some ascending movement, the vapor of the cloud and the drops of rain were brought in contact with air below the freezing point; and the large drops of water that fell on the western line of the shower must have been the result of a rapid condensation of vapor by contact with air slightly above that point. Is it not possible that owing to the different directions of the upper and lower strata of air, a rotary or upward movement may have been produced, drawing into it and elevating the vapor of the upper masses of cloud, the space thus created being filled by more elevated and colder masses, the motion of which to this point would account for the roar, as well as show how the condensation or congelation that took place might have been produced? In this case the lower air might have remained, as it certainly did, perfectly quiescent, while the upper air was in the greatest agitation.

Parhelia.

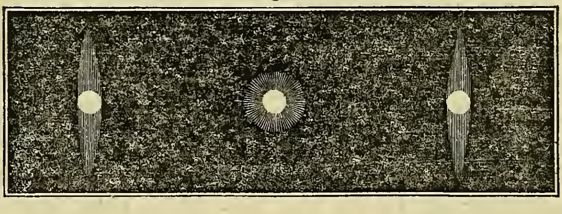
January 1st was the coldest day we have thus far had this year at this place. The thermometer at 7 o'clock was at $-12°$, at 9 o'clock $-10°$, and at 2 o'clock $-4°$. It had snowed constantly for about three days, and the average depth was not less than three feet, the wind from the north. On the 2d, the wind was N. W., the thermometer at 9 o'clock at zero, and at 2 o'clock 9° above. At sundown it sunk to 0. A dense haze seemed to hang like a curtain in the west, and a little before sundown, brilliant parhelia were seen, resembling two mock suns. Their appearance when about five degrees above the horizon was somewhat like the following :—

Fig. 1.



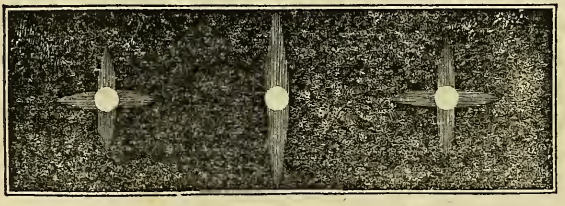
On Thursday the 16th of January, a day which was generally noted as one of the coldest ever known in this country, (the thermometer being at Albany $-26°$, at Schoharie $-36°$, at Utica $-21°$, at Syracuse $-14°$, at this place $-10°$, and at Franconia in New Hampshire $-41°$,) occurred another beautiful spectacle of this kind. When the sun was about a quarter of an hour high the appearance was as below.

Fig. 2.



The colors of the parhelia in this case rivalled the most splendid appearance of the rainbow, and retained them until the sun sunk below the horizon. At that time, what may be called the upper limbs of the parhelia seemed to stand like beautiful columns of colored light on the base of the horizon.

Fig. 3.



The next morning, the thermometer being at $-6°$, the moon which set at about 6 o'clock, for more than an hour before going down, exhibited the most perfect and splendid paraselene ever witnessed in this place. The appearance was as seen in Fig. 3;

and was destroyed only by the moon's passing behind a cloud a few moments before setting.

To what cause these meteorological phenomena are usually attributed I know not, unless to atmospheric vapor; but in all these cases they seem fairly to owe their origin to the state of the air consequent on the intense cold. The air in such a state of cold is filled with minute crystals of frost, and the reflection from these is perhaps sufficient to account for the general appearance. But the difference in the figure of these parhelia would seem to prove that this general cause must be subject to many modifications from other agents. Is this change of figure owing to the different forms which it is well known the crystals of snow assume at different times? The explanation I leave with you.

Meteorological Register.

Below I have prepared a table of the average temperature, the weather, winds, &c., for the years 1838 and 1839, as observed by me at this place. Otisco is about fifteen miles west of south from Syracuse, and at an elevation of eight or nine hundred feet above that place, on the Seneca branch of the Erie Canal.

Year.	Average Temperature.		Weather, Days.				Winds and Course.							
	9, A. M.	2, P. M.	Clear.	Cloudy.	Rain.	Snow.	N.	N. W.	W.	S. W.	S.	S. E.	E.	N. E.
1838	41	48	162	200	77	78	18	72	154	66	29	6	2	16
1839	42	51	184	184	89	55	19	66	135	62	42	26	23	10

The extreme range of the thermometer in 1838 was between $-8°$ on the last day of January, and 93° on the 9th day of July, giving 101°. The range for the year 1839 was $-9°$, January 23d, and 90° on the 30th of July, giving 99°. An instance of those sudden changes which occur in our climate, took place on the 19th of October, 1839, when the wind, which during the fore part of the day had been S. W., at half past 2 o'clock suddenly veered to N. W., and the thermometer fell from 65° to 24° in three and a half hours, a difference of 41 degrees.

I have for several years noticed the fact, that whatever may be the direction or course of the lower strata of clouds, that of the cirri, or highest of all clouds, is almost invariably from west to east. It is nothing uncommon to see the lower clouds drifting in heavy masses, and with a strong wind to the N. or N. E., while far above them, the streamers of the cirri are floating undisturbed towards the S. E. or E. Indeed it is very rarely observed that cirri take any other course, and it may fairly be inferred they never do, until by greater condensation they approach the nature of cumulus, and sink into the action and influence of the lower currents. From their observations on these clouds on the Cordilleras of South America and Mexico, Humboldt and Boussingault have inferred, and I think with good reason, that in the upper regions of the atmosphere there is a current constantly flowing from west to east, an inference which, if admitted, assists materially in developing the theory of storms, sudden changes of temperature, &c.

A glance at that part of the table showing the course of the wind will explain the fact noticed by Darby and others, that the mass of trees growing on the eastern shore of the great lakes have a sensible inclination to the east, and that in all cases where the hemlock occurs, the long, flexible, terminal twig of that tree has the same uniform declination from the perpendicular, and in the same direction, a little north of east. The same thing may be observed of orchards, in which probably nine tenths of the trees in exposed situations have a similar inclination. In the first year, two hundred and twenty days of the three hundred and sixty-five the winds were from the W. and S. W., and in the last one hundred and ninety-seven. The remaining days the winds were so equally divided as not to counteract this influence in the least, and consequently the winds from that quarter overpower all others.

The average temperature of the years 1838, 1839, and 1840, for the months of January and February, is given below.

	January.	February.
1838	26°	9°
1839	20°	24°
1840	14°	26°

Time of observation, 9 o'clock, A. M.

Thus, it seems January of this year averages 12° colder than 1838, and February of this year 17° warmer than that year.

The month of April with us has been remarkable for its extreme and rapid fluctuations. The warmest day recorded of any April here, was on the 25th. On that day the thermometer in the shade at 2 P. M. was at 85° and at 3 P. M. 86°;—on the 27th at 6 A. M. it stood at 28°; being a change of 58° in 37 hours. On the 18th at noon the thermometer was at 80°; on the 19th at sunrise, it was at 29°, being a change of 51° in 18 hours. The range of the thermometer from Jan. 1st, when it was −14°, to April 25th, when it was +86°, is 100°, a difference rarely equalled in our changeable climate.

Art. X.—*Phrenology.*

This curious and interesting branch of physical, intellectual and moral philosophy, has attracted much attention since the early years of the present century. The death of its great founder Dr. Gall in 1828, left the cause in the hands of his pupil, friend and coadjutor, the late Dr. Spurzheim, whose ability was equal to his zeal, and whose splendid and beneficent career was terminated in Boston in this country in 1832.* During the few months that he survived after his arrival in the United States, he made a strong impression both in favor of phrenology, and of his own elevated and noble character, while a deep sentiment of grief and disappointment pervaded the country when, by a mysterious providence, he was suddenly cut down, in the full maturity of his powers. Notwithstanding the labors of several ingenious and eloquent men, especially Dr. Charles Caldwell, Dr. Jonathan Barber and Mr. Christopher Dunkin, many persons were desirous of hearing this subject explained and enforced by the distinguished writer and teacher, George Combe, Esq., of Edinburgh, who was therefore invited to cross the Atlantic for this purpose.

Since his arrival, about eighteen months ago, he has given nine full courses of lectures on phrenology, in different cities and towns in the United States; in our last number, (p. 390,) we mentioned the course with which he has now closed his labors in this country, and that it was attended with high interest by a large and intelligent audience. At the conclusion of the last lecture, and after Mr. Combe had taken leave and withdrawn, the audience was called to order by the Hon. Henry W. Edwards, late Governor of Connecticut.

The Hon. David Daggett, late Chief Justice of the State, was called to the chair, when the following resolutions were laid in by Gov. Edwards, seconded by Prof. Silliman, and carried by an unanimous vote. We trust that our readers will agree with us that it is not inappropriate to the object of a Journal of Sci-

* See an interesting memoir of him by the late lamented Dr. Follen, an abstract of which is given in Vol. xxiii, at p. 356 of this Journal.

Our foreign readers may not be aware that Dr. Follen was a countryman of Dr. Spurzheim, and met his tragical death, in the nocturnal conflagration of the Steam Boat Lexington in Long Island Sound, January 13, 1840, with one hundred and twenty-three other sufferers; "multis ille bonis flebilis occidit."

ence, to record them with the remarks by which they were supported.

The observations of Gov. Edwards *on introducing the resolutions, were as follows.*

We have been listening with great interest and instruction during a series of evenings* to the lectures of Mr. Combe on phrenology, and his course is now finished. He has displayed much ability and great research on this subject, and whatever our opinions may finally be as to the correctness of the views he has presented, I think we shall readily admit, that he has acquitted himself fairly and fully in what he undertook. For one I am ready to declare, that he has accomplished all that I had anticipated. He has performed to my entire satisfaction his part of the engagement. If there be truth in phrenology, the sooner we know it the better. The subject is of immense importance, and if we are still in doubt, we have been furnished with the means of ascertaining the truth.

Mr. Combe is now about to leave us, and an expression of our approbation, in accordance with what has been done at other places, where he has lectured, is I think due from us, and will probably be very gratifying to him. I hold in my hand some resolutions which will be submitted to the meeting, and will it is presumed, be cheerfully concurred in by all present.

RESOLUTIONS.

Resolved, That we have listened with great interest to the lectures of Mr. Combe, on the physical, intellectual and moral powers of man, and that without claiming to express an opinion on phrenology, as a science, we have derived from his skilful analysis, both instruction and gratification.

Resolved, That our best wishes attend Mr. Combe and his lady, for a safe return to their native land, and a happy reunion with their friends.

Resolved, That Judge Daggett, Gov. Edwards, Prof. Silliman, Gen. Kimberly, and Prof. Olmsted, be a committee to present to Mr. Combe, a copy of the above resolutions.

New Haven, Conn., March 15, 1840.

* The course occupied thirteen evenings, each lecture being two hours long, with a brief intermission.

The resolutions were communicated to Mr. Combe with the letter, of which the following is a copy.

TO MR. GEORGE COMBE.

Dear Sir—In compliance with the request of the gentlemen and ladies who have attended your course of lectures on phrenology, we have the pleasure of presenting you with a copy of the resolutions adopted by them, and avail ourselves of the occasion to communicate the assurance of our high respect and esteem.

DAVID DAGGETT,
HENRY W. EDWARDS,
BENJAMIN SILLIMAN,
DENNIS KIMBERLY,
DENISON OLMSTED.

New Haven, March 15, 1840.

Remarks of Prof.* SILLIMAN *in support of the above resolutions.*

Mr. Chairman—I beg leave to second the resolutions just moved by the honorable gentleman. I have no doubt sir, that I express the sentiments of this audience when I say, in the spirit of the first resolution, that I have listened to the lectures of Mr. Combe with great satisfaction, and that I have found them replete not only with entertainment but with instruction.

I perfectly agree in opinion with the mover of the resolutions that phrenology, if true, is a very important science. In relation to its early history, permit me, therefore, to state a few facts that came within my personal knowledge, and which have a bearing upon some of the statements of our respected lecturer.

It was my fortune Sir, while in Edinburgh in 1805–6, to sit, both in and out of the University, at the feet of several of the able teachers, whom Mr. Combe has named. Some of his instructors

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* It is proper to observe, that these remarks were uttered, *on the excitement of the moment*, without reference to any other object, than the carrying of the resolutions. But a wish having been expressed in various quarters, that an account of the whole of the proceedings might appear before the public, this report was first prepared with reference to the newspapers; it was thought however to be too much extended for that channel of communication, and that justice to Mr. Combe demanded a more permanent form of publication, especially as his European friends might be gratified by adding this to the proofs already given in other places of his very favorable reception in this country. It may be perceived by those who heard the substance of the following remarks, that they are now carried out more fully than in the delivery, as the time was then limited.

were also mine: and of this number were the late Dr. James Gregory, the late Dr. John Murray, and the late Dr. John Barclay.* Among these gentlemen—all of whom were very able in their respective departments, Dr. Barclay was particularly distinguished for his extraordinary talents and science; and although he was only a private lecturer on anatomy, so highly was his course appreciated, that many students of the University, after paying for the ticket of the Professor, took also that of Dr. Barclay, and in great numbers crowded his anatomical theatre. Among many others, I was one of his attentive hearers.

Dr. Barclay did not confine himself merely to the technical anatomy of the human frame: he was in the habit of illustrating the natural history of man, by comparing man with himself, and man also with the inferior animals, thus opening to us the rich field of comparative anatomy. Mr. Combe has mentioned that Dr. Barclay made it an important object to trace the progress of intelligence through the lower animals up to man, and through the principal families of the human race. Although, at that time, phrenology was hardly known in Britain, even by name, Dr. Barclay was, perhaps unconsciously, demonstrating the fundamental principles of the science.

I have much pleasure in confirming the statement of Mr. Combe, having often seen Dr. Barclay's tables covered with skulls, arranged in a series, beginning with some of the less intelligent of the lower orders of animals and then ascending in regular gradation through the more intelligent, up to man.

It was his great object to prove that the facial angle originally indicated by Camper, was the type of intelligence, it being larger as the head to which it belongs is more highly endowed with intellect.

It will be remembered, that in man, the facial angle is included between two lines, one of which is drawn through the external opening of the ear, under the zygomatic arch and just beneath the cheek bone to the base of the nose, while the intersecting line passes along from the middle of the forehead over the inner

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* The painful word *late* I am happy to withhold from two of the eminent men to whom I then listened, Dr. Thomas Thomson, now the Regius Professor of Chemistry in the University of Glasgow, and Dr. Thomas Hope, still the veteran Professor of Chemistry in the University of Edinburgh, both of whom happily survive in vigor and usefulness. Prof. Jameson and Sir David Brewster, whose orbs were then in the ascendant, are now evening stars of the first magnitude.

angle of the eye, down by the nose and across the mouth. In man, provided he is not an idiot, this angle is always considerable compared with that in most of the inferior animals.* Dr. Barclay used to lay upon the table the head, for example, of a crocodile or alligator in which the intelligence is low, and the facial angle so small as to be very acute, and he would follow out the analogy, through the other reptiles, through the fishes, the cetacea, the birds, the quadrupeds, the quadrumana, (monkeys, and ourang outangs, those caricatures of our race,) and so on, up to man.

He was fond of describing the skulls of individuals of many nations and countries; for instance, of barbarous and animal man, as seen in the natives of Van Dieman's land, of Australasia, of New Zealand, in the Carib of South America or the West India Islands, and in the North American Indian; of man in a more heroic but ferocious bearing, in the Bedouin Arab, the indomitable Moor, and the nomadic Tartar; in a milder form, in the Hottentot and Negro; with still gentler modifications, in the half civilized Mexican and Peruvian, and in the amiable Hindoo; in an improved condition in the ingenious Chinese, the effeminate Georgian, the indolent Turk, the incredulous Jew, and lastly, in the civilized European, appearing at one time as a peasant, at another as an artisan—and to crown the whole, in the highest elevation of the human character, as a philosopher and an enlightened moralist.

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* The above will answer for a popular description; the following is more precise. The facial line is drawn from the anterior edge of the upper jaw to the most prominent part of the forehead, which is usually the space between the superciliary ridges. A second or horizontal line is drawn through the meatus auditorius till it touches the base of the nostrils and from this point it is still prolonged until it meets with the facial line already described; hence the two lines may meet at or very near the nasal spine or base of the nose, but in other instances, at a point considerably anterior to the bone; this is the facial angle, whose maximum according to Camper, is 100°, unless in heads preternaturally large, as in hydrocephalus. The most ancient Greek artists chose the very maximum of the facial angle, while the Roman graveurs were satisfied with 95°. According to Camper the facial angle varies between 70° and 100°, from the head of the negro to the sublime beauty of the ancient Greek models. "If" he remarks, "we descend below 70°, we have an ourang outang or a monkey; if still lower, a dog or a bird, a snipe for example, of which the facial angle is almost parallel with a horizontal plane." The facial angle as first indicated by Camper was not an accurate index of intelligence, but in the improved mode of measurement by the facial goniometer described by Dr. Morton, the objections to it are in a great measure removed.—Dissertation &c. quoted by Dr. S. G. Morton, Crania Americana, p. 250.

Although I could not always follow the facial angle through the various orders of animals,—still, I entertained, at the time, no doubt, that my admired instructor was right in his main argument, and I was delighted to see it sustained through such beautiful gradations and coincidences of structure and intelligence.

I do not recollect that I then entertained the smallest conception of the application of the doctrine to man, as an individual, and far less of distinguishing in the same individual, structural proofs of different mental manifestations. The enlargement and rise of the frontal and superior regions, in some general ratio to the advancing intelligence of animals and men, appeared to be established, and this structure seemed decidedly to predominate in the Caucasian or European race, as compared with the barbarous nations.

We have been informed by Mr. Combe that Dr. Barclay was not friendly to phrenology—a fact, which I suppose appeared in subsequent years. Still, it was remarkable that no man in Britain, and few men, any where, had then done more to lay the foundations of this science, and therefore it is not surprising that his results should appear so valuable to the phrenologists of the present day.

Mr. Chairman, I have no claim to be called a phrenologist, for I have not studied the subject sufficiently to form an opinion upon the science *as a whole*, and it is not probable that my engagements will ever permit me to give it a thorough investigation. All I know of it is derived from the courses of lectures which I have heard, and of which this is the fourth; from observation of such facts as have come in my way; from credible attestations of its practical applications published in various works, and from personal communications with some of its cultivators. Among these, our late respected lecturer is, after Dr. Spurzheim, the most distinguished, whom it has been my good fortune to know; for, that eminent man, soon after his arrival in this country, in 1832, spent many hours in my family, on which occasions, however, (such was his modesty) he never, of his own accord, introduced phrenology into conversation, and spoke of it only when invited; then indeed, he was frank respecting it, as he was always instructive on every subject; for, his great knowledge, rendered attractive by his perspicuity, simplicity and benevolence, was sure to delight his hearers.

It certainly does not become one who has not made phrenology a particular study, to say much of his own impressions, nor to claim for them great consideration. Without presuming to dictate, I beg leave, however, to enquire for a few moments, whether there is any thing in its claims and pursuits which is absurd, unphilosophical, or of irreligious tendency.

We have, each for ourselves, no better means of judging, than by the effects which the evidence and the discussions produce on our own minds; nor can we, understand, why some persons of great intelligence and worth, treat phrenology as if it were, on its very front, ridiculous and absurd, and therefore to be dismissed with contempt and ridicule, as the dream of an enthusiast—or to be spurned as the invention of an impostor—while some disciplined minds regard the investigation as unphilosophical, and still greater numbers shrink from it with dread, as tending to impair moral responsibility, or to bind us in the fatal folds of materialism.

It appears to me, sir, that phrenology involves no absurdity, nor any antecedent improbability. The very word means the science or knowledge of the mind, which all admit to be a pursuit of the highest dignity and importance, both for this life and the life to come, and the appropriate enquiry of the phrenologist is, whether the mind, with its peculiar powers, affections and propensities, is manifested by particular organs corresponding with the conformation of the cranium, that defensive armor by which the brain is protected from external injury.

In what part of our frames is the mind manifested by any visible appearance?

All will answer, in the features, in the human face divine, through whose beautiful and impressive lineaments, the mind shines forth as through windows, placed there on purpose, by the Creator. In this all are agreed; we read there, in language which is often quite intelligible, the decisions of the will and the judgment, and the fluctuations of the affections. Even the inferior animals both manifest to us, and understand from us, this visible language, figured and shadowed forth by the form and movements of the muscles of the face, and especially by the effulgence of the eye.

But whence comes the intellectual and moral light that beams forth from the eye and from the features?

Surely, not from the eye itself, although it is the most perfect and beautiful of optical instruments; not from the fibres of the facial muscles; not from the bony skeleton of the face; not from the air cells and blood vessels of the lungs; still less, from the viscera and limbs; and with equal certainty, not from the cavities, the valves, and the strong muscular fabric of the heart itself, which is only the grand hydraulic organ for receiving and propelling the blood, in its double circulation both through the entire body to recruit its waste, and through the lungs, to receive the beneficent influence of the oxygen of the air, without which, in its next circulation through the body, the altered blood would prove a poison.

Most persons are startled when told, that the physical heart has nothing to do with our mental or moral manifestations. What! does not its quick pulsation, its tumultuous and irregular throb, when fear, or love, or joy, or anger animates our faculties—does not this bounding movement, shooting a thrill through the bosom, nor the attendant blush, or death-like paleness of the features, prove that the heart is a mental or moral organ? Certainly not; these phenomena only evince that by means of our nerves, the divine principle within electrifies us, as it were, our muscles and thus accelerates or retards the current of the blood through the arteries, as well as the movement of the muscles themselves, and especially of the heart, which, in relation to the circulation of the blood, is the most important of them all. The physical heart is no more to the mind and the affections, than the hose of a fire engine is to the intelligence that works the machine, whose successive strokes impel the hurrying fluid along, in a manner not unlike that which attends the circulation of the blood in the arteries.

Where then shall we look for the seat of the mind? We are seriously assured that some persons have believed the stomach to be the favored region. The stomach, with its various coats, its innumerable nerves and blood vessels, its muscular tissues, and its gastric secretions, is a mere cavity for the reception of aliment; it is alternately distended with food and fluids, or partially collapsed by inanition, and although exquisitely sensible, by its nervous apparatus, both to external and internal injury, all that belongs to it is obviously required for the discharge of its appropriate functions in the reception and digestion of aliment; no office by it performed, no sensation there experienced, indicates it to be any thing else than an organ, indispensable indeed to the physical support and nourishment of the body, but in no degree the residence of the mind.

On this position we cannot consent to argue further, and if there be any persons who seriously believe that the mind and affections reside in the stomach, we can only say, that in this case, we have no perceptions in common, and that the proof which convinces us would probably be lost upon them.

We are then at last, compelled, to return to the head, from which intellectual citadel we should never, for a moment, have departed, did not some individuals affirm that they are not sure where their minds reside.

Such a doubt fills me with amazement, for I am as distinctly conscious that my mental operations are in my head, as I am of my existence, or that my eyes present to me the images of external things ; nay more, I am equally certain, that no merely intellectual or moral operation has its seat below the bottom of the orbital cavities; that all the wonderful and beautiful structure beneath the base of the brain quite to the soles of the feet, is composed merely of corporeal members, of ministering servants, that obey the will and execute the mandates of the heavenly principle, the representative of the Creator residing within the beautiful dome that crowns our frames, and which, like the lofty rotunda of a holy and magnificent temple, covers the inhabitant beneath, while it looks upward to heaven, with aspirations toward its divine author and architect.

Are we then expected seriously to assert, that which appears self-evident, that the seat of our mental operations, and of our affections and propensities, is in the brain? My consciousness informs me so, and this is the highest possible evidence to me, although *my* consciousness cannot be evidence to another person. Were it possible for life to exist with the body detached from the head, the latter might perhaps be even capable of thinking for a short time, without the appendage of trunk and limbs. Indeed, we are sure, that dislocation of the neck, while it has paralyzed and rendered insensible all the parts below, so that the individual ceases to be conscious that he possesses a body, has often left the mind in full operation. Provided the luxation or other severe injury has taken place below the vertebræ from which proceed the nerves that supply the lungs, the sufferer continues to breathe and to converse, manifesting a rational mind as before the accident. Death must of course soon follow, and as to perception, the body is already dead; but the continued activity and soundness of the mind prove that its residence is in the brain. This fact appears to me decisive, as no one would imagine that the lungs, a mere light tissue of air cells and blood vessels, separated by thin membranes, and destined only for circulation and respiration, can contain the mind—especially as this noble power is not subverted in chronic diseases of the lungs, not even when their substance is almost removed by a wasting consumption.*

The residence of the mind being in the brain, it is not absurd or irrational to inquire whether it can be read in the form of the cranium as well as in the expression of the features.

It would appear from the observations of Dr. Barclay, that there is at least a general conformation that indicates intellectual and moral powers, and we are thus led to ask whether the research for more particular manifestations is unphilosophical. On this point, we ought not to depart from the received rules of sound philosophy. We are accustomed, in all other cases of scientific inquiry, to examine and weigh the evidence of phenomena, and to apply to them the severe canons of induction, nor can we discern, in the present case, any reason for a different course.

If, as has been ascertained by physiologists and anatomists, the bony matter of the cranium is deposited upon and around the membranous envelops of the brain, which is formed before the skull, then, the latter adapting itself in its soft and yielding state, must, of necessity, take the shape of the former; if the different faculties, affections and propensities of the mind are distributed in different organs contained in the convolutions of the brain,

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* Dropsy in the brain does not form an objection, because its appropriate seat is in the ventricles or cavities, and by the very postulates of phrenology, a particular organ, or particular organs of the brain may be diseased, or even destroyed, without subverting the action of the mind, except in the part affected.

The case of Sir Robert Liston, mentioned by Mr. Combe, is very remarkable on this point, as his intellectual powers remained unimpaired, while the organs of wonder, combativeness, and language were affected on one side. I had the pleasure of knowing him at his beautiful cottage near Edinburgh, when all his faculties were perfect, and nothing was at that time more removed from his conduct and character than the frantic anger which he afterwards manifested in a state of the brain, ascertained by post mortem examination, to be diseased in the three animal organs.

and if the energy of the faculties is in proportion to the size and development of the organs, then the external form and size of the cranium will indicate the powers and affections within, due allowance being made for the varying depth of the frontal sinus, and for some other peculiarities of idiosyncrasy or of disease, affecting the thickness and development of the bone in different individuals.

This then is the vexed question—is there such a correspondence—are the views of phrenologists sustained by facts, and do the prevailing powers, affections and propensities of individuals, correspond with the cranial developments, modified by the temperaments, by health and other circumstances? It is obvious that these questions can be answered only by persons of large observation, of great mental acumen and extensive and accurate knowledge of the structure, physiology, and history of man. The investigation includes, in the widest sense, all that belongs to him, and therefore few persons are qualified to make such responsible decisions. They have been made, however, in so many instances with success, as to command confidence and to conciliate favor.

It was seriously proposed to the British government in 1836, and the application was sustained by many professional men of high authority, that the numerous convicts who are annually transported to Australasia and Van Dieman's land, should be examined, phrenologically, that the dangerous criminals may be separated from the rest, allotted to a more rigorous supervision, and controlled by military force, both on the passage and in the colonies;—that on landing, they should be stationed at labor under guard, on the roads and other public works, while the milder individuals, being placed out as servants, might become safe and useful inmates in families, or laborers on the farms, and thus there might be a better prospect of their acquiring the confidence of their employers and of recovering their own self-respect.

In New Holland, this course is very important, as appears particularly from the able report on the exploration of a large portion of that immense country by Major T. L. Mitchell,* who under the authority of government, and as surveyor general, made three ar-

* His report was published in London in 1838, in two beautiful 8vos, with numerous illustrations by plates and maps, a very valuable work, which we have read with great interest.

duous and perilous tours into the interior of Eastern Australasia, Australia Felix and New South Wales. The remote situation of the farms and establishments for raising cattle and sheep, renders it particularly important that they should not be exposed to the depredations and plots of abandoned and desperate villains.

It is also obvious, that in prison discipline, those who have only begun in the career of villainy, should not be exposed to contamination from individuals who are not only great criminals in fact, but constitutionally propense to crime. We certainly know, independently of phrenology, that such propensities and predispositions exist, and it is obviously important to avail ourselves of all possible sources of light on this subject, so important to the community. It becomes, therefore, an inquiry of deep interest, whether, in the power to make these discriminations, we may not repose full confidence in such men as Dr. Gall, Dr. Spurzheim, Mr. George Combe, and other individuals of similar experience and ability.

Perhaps we may not be able to follow them in all their detailed divisions of the position of the faculties, affections, and propensities; but, after making all reasonable allowance for some possible errors in discrimination, and for some suggestions of the imagination, may we not still rely upon their ability to indicate, decidedly, the prevailing faculties and the ruling affections and propensities of far the greater number of individuals, in any assembly, either of pupils or convicts, or of people brought together by accident?

In yielding to our convictions on this subject, we should, however, exclude smatterers and pretenders, who, having only a superficial acquaintance with the subject, and perhaps no uncommon acumen in any case, examine heads to flatter self-esteem, and gratify cupidity.

The subject is liable to abuse, and not all who claim to be phrenologists, can be deserving of entire confidence; but is not the same true of many other subjects, and especially of surgery? How large a proportion of surgeons should we be willing to employ, in passing a knife among the nerves and arteries of our own bodies, or of those of our dear friends?

We are persuaded then that phrenology has its foundations laid in truth, and that its first principles, as regards the great regions of the head, are established upon the same ground as that which sustains all the physical sciences, namely, induction, indicating the correspondence of the phenomena with the theory.

Those who have not profoundly studied the science, cannot judge of the details; it certainly appears very extraordinary that numerous organs should be included within a mass no larger than the brain, and that so many faculties should be found in particular regions, especially in that of observation along the front and lower portion of the brain, contiguous to the eyes and the arches of their orbits. It appears the more strange, inasmuch as dissection does not enable us perfectly to separate the different organs, although the convolutions of the brain are distinct, and may indeed be dissected apart; but there are no visible boundaries between the organs, so that they can be removed, one by one. There is however an apparatus by which communication is made to them and through them by the medium of nervous fibres; many groups of these fibres are visible in the brain, pervading different organs, and therefore we may presume that, where we cannot see them they may still exist, and perform their office of communicating their appropriate impressions.

Strong analogies favor this view. For example, in addition to the nerves and blood vessels that may be traced in every part of the body, there are certainly others that exist in inconceivable numbers and with an infinitesimal minuteness, baffling equally our powers of vision and dissection, and even of conception; for, whatever part of the system we puncture with a needle or other sharp instrument, we both draw blood and excite pain, thus proving that not only blood vessels but nerves of vanishing minuteness pervade the entire structure, and every one of these blood vessels receives its stores of blood from the circulation that is sustained by the contractions of the heart, faithfully returning the vital fluid again to that organ; in the same manner, the infinitely divided nervous fibres all communicate ultimately with the brain, and thus when they are wounded, impart the information from the remotest extremities to the grand head quarters of the mind, and that quicker than an electric movement in our machines, or in the atmosphere, or in the wide external world.

But this is not the ultimate term of infinitesimal minuteness. While every part of the system is thus furnished with nerves of common sensation, so that we suffer by a wound inflicted in any place, and the mind is instantly informed of the injury; there are, in addition to these, nerves of voluntary motion, by means of which those parts of our bodies that are obedient to our will, (the voluntary muscles,) receive the orders we give them—as in the limbs, to walk, to run, to leap, to skate or dance; or in the arms to fence or fight, and the members promptly move in accordance; the features, by the action of the voluntary muscles of the face, report our mental or moral movements, or our animal feelings; the eyes roll in their orbits "with a fine phrenzy," or shine with intellectual lustre; the tongue, the glottis, the muscles of respiration, and all the parts that are concerned in speech or in producing the tones of vocal music, give the voice its utterance, its compass, its various cadence and intonations; the fingers move the pen or sweep the lyre, or strike the keys of the piano forte or of the organ, or stop and open the apertures of the flute and clarionet. All this and much more that need not be named, is done in obedience to our will, but with a celerity and precision too great even for thought to frame distinctly the conception, before it is executed.

Nor is this all: the organs of sense are furnished with nerves appropriate to their destination of conveying to the mind their peculiar impressions, while at the same time, like the whole body, they are endowed with nerves of common sensation; thus, the tongue or the nostrils receive pain from the puncture of a needle, while the needle does not produce taste in the tongue nor smell in the nostrils; but sugar placed on the tongue, or a rose at the nostrils, produces the appropriate pleasurable sensation, while pain would be excited at the same instant, in each of these organs by the point of a pin or a needle. Here then are appropriate nerves of infinite minuteness spread over the organs of sense—other nerves also of common sensation, and in most cases, still others of voluntary motion, while these complicated tissues of nervous network, not only do exist together, but they perform their functions simultaneously, although in perfect independence, and without the smallest degree of confusion. It is admitted by anatomists that a similar delicacy of nervous structure exists in the brain, whose very object is to receive and convey nervous influence, and since we can observe nervous fibres in all parts of the body and also in the brain, until our eyes and our glasses fail to detect such minute ramifications, we have therefore the same evidence for all the minuteness of division among the nerves of the brain which the phrenologist may desire to prove, equally with that which the mere anatomist finds or presumes to exist in all the other organs.

The cases being perfectly parallel, no objection can be urged against the one that does not apply also to the other, and the arguments in support of both are quite in common.

It thus appears that the existence of many organs in the brain, with their appropriate nervous apparatus, is in no way inconsistent with the general analogies of structure in the body.

Other analogies might be found in the lacteals and absorbents, systems of vessels having again, inconceivable minuteness as well as great extent, and still operating without interference with any of the other systems in the body, while they perform their own appropriate and most important functions. It is then not only possible that there may be different organs in the brain adapted to different manifestations, but there appears a strong antecedent probability in favor of such a structure.

We may now assume that the mind is local to the brain, and that there are no indications of intellectual operations or moral affections in any other parts of the system; and notwithstanding the vague remarks which sometimes fall even from people of understanding, implying that they are uncertain where their minds reside, we must conclude that this indistinctness of conception arises simply from their neglect to think accurately at all on the question, or from a fear that if this first step is admitted, phrenology will claim much more, and demand the admission of all the organs, each with its appropriate location.

Plainly then, if there be so much locality in the mind that it resides in the brain, there may be a distribution of faculties still more definite and different manifestations may belong to different parts of this organ. Let us observe also that locality is predicable of every portion of the body. The bones are appropriate to the different members and to the various parts of the trunk and head. The proper muscles are spread over the frame for voluntary or involuntary motion: the mouth receives the food, the teeth masticate it, the saliva, discharged from appropriate local glands, dilutes it, so that it can pass down the esophagus to the stomach, where it is digested; it is mingled with the bile secreted by the liver and stored in the gall bladder; the intestines receive it in the state of chyme to be subjected to the action of the lacteals, which are ready with their myriads of mouths to take up the chyle or nutritious portion, which is conveyed, as a milky fluid, through appropriate vessels to the left subclavian vein, by means of which it is poured into the mass of the blood to recruit its waste.

All our senses except feeling are local, and most of our organs are double; the eye and the ear, each in pairs, corresponding to the double brain, are placed close to that intellectual organ, and communicate directly with it; they are the most elevated and dignified of the senses, and are worthy of their honorable neighborhood. The nostrils are also double, while the tongue is single, although composed of two perfectly similar halves. These organs of sense are in the descending scale of honor, and their communications with the brain are less direct than those of the eye and ear; the pleasures we enjoy from them have their seat also in the organs themselves, while those of sight and hearing are in the mind, and the organ itself is not sensible of the pleasure. Thus the pleasures of sight and hearing are almost intellectual. Lastly, the sense of feeling is perceived over all the surfaces; it has no particular locality, but varies in intensity with the number and delicacy of the nerves belonging to this sense in particular parts.

The numerous glands existing in many parts of the body for the secretion of saliva, of mucus, of milk, of bile, and other things are instances of local organs. The lungs are a very remarkable example of an organ for a specific purpose; and they, like the heart, are required to be in constant action while life continues. We have already cited the arteries and veins which are local in their respective courses, while the blood which passes through them is thus compelled to move in its appointed channels. The nerves also have been named with the same intention, and in many instances they are sent forth in pairs to supply correspondent double portions of the body. It is not necessary to cite other instances of local organs destined for particular and some of them most important purposes, as they will occur on the slightest reflection, and it is thus proved that locality is almost universally characteristic of the structure of the body.

It would then be strange indeed if there were no organ devoted to the mind. What organ can be the residence of the mental faculties if the brain is not? Every other has its uses, in general well ascertained, but, without mental manifestations, there is no use for the brain; for even the nerves that proceed from it, would be nugatory without the mind to issue its orders through them to the members, and to receive in turn communications from them, and the circulation of the blood through an useless organ, would be quite superfluous.

Many persons are alarmed, lest phrenology should produce an influence hostile to religion, by favoring materialism. It is supposed that our organization may be pleaded in bar, against our moral responsibility, since, if we have strong dispositions to do wrong and no power to do right, we are like machines and are not responsible. When there is no intellectual power, as in the case of an idiot, or a subversion of reason, as in the instance of a maniac, it is agreed by all, that the individual is not amenable to human laws. This opinion has no reference to phrenology, and is embraced by all mankind.

If we have rightly understood Mr. Combe, he holds that the individuals in whose heads the intellectual and moral sentiments predominate, are highly responsible; those in whom the three classes of organs are in equilibrio, are considered as still responsible, but entitled to much mercy combined with justice, on account of their strong temptations; while those who are sadly deficient in the moral and intellectual organs, are regarded as moral patients.

From the latter class we slide down insensibly to intellectual idiots, whom all regard as not responsible. Where shall we draw the line? The common sense of mankind is agreed upon the principle, but some difficulty is found in the application to particular cases on account of the infinitely varying degree of intellectual and moral power.

There are also peculiar cases, as those of monomania, which are treated with indulgence and exempted, to a certain extent, from responsibility, while there are also other cases still, of a doubtful character, which must be judged under their peculiar circumstances, and cannot easily be brought under any general rules. As regards organization, it is obvious that our condition in this world is dependent upon it, and that it influences all our actions and arrangements. Organization is the foundation of human society; upon it depend our dearest relations in life, many of our highest enjoyments, all our intellectual efforts,* and our most exalted virtues;

* Since we have no knowledge of a human mind unconnected with a brain.

from its abuse, on the contrary, spring some of the most flagitious crimes and most poignant sufferings. Still, no court permits a criminal to plead against his condemnation, the strength of his evil propensities which have led him to the commission of crime. The temptations of cupidity will not excuse the felon from transportation; nor the fierceness of anger or the delusions of inebriety avert the sentence of death from a murderer. Phrenology does not, in the least, alter the case; for, independently of this science or of any other relating to our frames—as, for instance, anatomy and physiology—we are quite sure of the existence of our faculties, our affections, and our propensities, and we know that we are responsible for their proper use and for their abuse. Their manifestation through the brain does not affect our moral responsibility, any more than if they were associated with any other parts of our frame, or diffused through the whole of it, without any particular locality.

It is our duty to regulate and control all our powers, affections and propensities, and nothing but the impotency or subversion of our reason can excuse us from moral responsibility. We will suppose, for instance, that according to the language of phrenology, a man may have small intellectual powers, little conscientiousness and benevolence, and large acquisitiveness, destructiveness and combativeness. Will he therefore stand excused for theft or murder? Certainly not. It was his duty to obey his conscience, and to resist his animal propensities when they would lead him to evil. Feeble faculties and dispositions may become strong by cultivation and encouragement, and strong propensities may be controlled and subjected by vigilant discipline. We see in life, many examples of self-government producing, by the force of a voluntary discipline, fine characters, formed as it may be out of very imperfect or bad materials, while brilliant intellectual powers and elevated moral feelings are, unhappily, too often subdued by the lower propensities, the animal powers; in these cases, the latter were not governed, and thus the intellect which should have been the master, became a miserable and ruined slave to the propensities. If the case of the feebler powers and stronger propensities admits of no justification, the opposite case presents no palliation; for with a strong intellect and a conscience quick to distinguish right from wrong, the propensities ought to be subjected to the most perfect control. Phrenology, therefore, stands not in the way of moral and religious influence; but, on the contrary, if the science be true, it indicates in a manner most important, where and how to exert the discipline of self-control as well as the right and power of controlling others. This discovery will, indeed, without phrenology, be made in the progress of the experience of the individual, but it may be at too late a day. Health, conscience, fortune and honor may have been sacrificed, when, had the point of danger been early made known, and the course of safety seasonably indicated, the peril might have been shunned or averted, and peace and security insured.

But, the Christian will anxiously enquire, is our safety then to depend on our own imperfect knowledge and resolution in performing our duty? We answer, that however ignorant and weak we may be, there can be no doubt that our Creator has placed us here in a state of discipline, and that we are under bonds to him to perform our duty, despite of evil influences from within, and of temptations from without. If, however, phrenology will enable the anxious parent to understand the powers and capacities, with the prevailing affections and propensities—it cannot but influence the destination and pursuits of the child, while it will also indicate the course of discipline and treatment.

But all this will not avail, without superior influence flowing from the Creator himself, through his divine revelation, which is the charter of our hopes, and our supreme moral guide in life. If there be in any instance, an unhappy cranial formation, surely it does not diminish, but, on the contrary, it enhances the necessity of a prevailing heavenly influence to illuminate that which is dark, to strengthen the weak faculties, subdue the wild animal propensities, and purify, by a holy efficiency, the moral sentiments and affections.

Religion can therefore do, what phrenology cannot alone effect. Phrenology undertakes to accomplish for man, what philosophy performs for the external world; it claims to disclose the real state of things, and to present nature, unveiled, and in her true features.

As science and art build upon the laws of nature, and borrowing materials from her, proceed to construct all the machines and edifices and various physical furniture of refined civilization, so phrenology, if successful in developing the real powers, affections and propensities of man, furnishes to revealed religion, in the best possible state, the subject upon which through the spirit of God, the holiest and happiest influences of piety may be exerted and made effectual.

Phrenology then, is not a substitute for revealed religion—it does not present itself as a rival or an enemy, but as an ally or ministering servant. It is obvious that if all which is claimed for it be true, it is capable of exerting a most important influence on the faculties and moral powers of our race, and with experience for its interpreter, it must form the basis of intellectual philosophy.

The development which it makes of the faculties as connected with the organization of the brain, illustrates the wisdom of the Creator in common with the wonderful structure of the rest of the frame, and indeed it has still higher claims to our admiration, in as much as the faculties of the mind are more elevated in dignity than those of the inferior members. If it should be objected, that we ought not to attribute to God a structure in which evil propensities are included, we answer that they cease to be evil if they are controlled by the superior powers, and after all, the introduction of moral and physical evil into this world must be referred to the will of God, nor does it at all change the conditions of the problem, whether our moral errors arise from our organization or from external influences, or from both. In either case, we are responsible, because power, either inherent in our constitution, or imparted through the influence of religion, is given to us, sufficient to resist moral evil and to perform our duty. It appears then, that phrenology is neither an unreasonable, an unphilosophical, nor an immoral or irreligious pursuit.

The connection which it proves between the brain and the mind, is founded upon our personal experience and daily observation. There is nothing in the nature of the brain which can enable us to understand how it is made the residence or instrument of the mind, nor can we in the least comprehend, in what way the mind will subsist after the death of the body, or in what the intellectual essence consists. We are indeed instructed, from the highest authority, (and the thought, with its illustration, is equally beautiful and sublime, in a philosophical as in a moral view,) that "the seed which we sow* is not quickened unless it die; that we do not sow the body that shall be, but that God giv-

* "Bare grain, it may chance of wheat or of some other grain."

eth it a body, as it hath pleased him, and to every seed his own body; so also in the resurrection of the dead; it is sown in corruption, it is raised in incorruption; it is sown in dishonor, it is raised in glory; it is sown in weakness, it is raised in power; it is sown a natural body, it is raised a spiritual body; there is a natural body, and there is a spiritual body." (St. Paul.)

Of the future association of our minds with that new and spiritual body, we can no more form a distinct conception, than we now do of the existing connection with our living acting frames. They obey the mandates of God's vicegerent, the immortal mind, which is truly and locally enthroned in the superior region of the head, to rule the inferior body, employing its members as servants to fulfil its commands, and in that manner to accomplish the will of the infinite Creator. Great dignity is thus imparted to our reason and to its temporary residence in the head, its truly regal palace. But the human mind soon finds the limits of its power in every department of nature. It comprehends indeed, the celestial mechanism, and demonstrates the existence and the ratio of gravitation and projection, but understands not their nature and origin; it penetrates the chemical constitution of bodies, and ascertains the laws by which the heterogeneous atoms rush into union, while it cannot fathom the essence of the particles, nor even prove the reality of matter. The mind commands the hand to move, and it instantly obeys, to perform its behests of anger or of love—while the mind itself perceives not the nature of the influence, nor the manner of its movement, and thus phrenology forms a perfect parallel with all we know of nature and of nature's God. With us, rests the knowledge of the effects; with him, the cause and the manner of the connection. Philosophy then, equally with religion, bows before the throne of the Supreme, and while it renders grateful homage for the glorious illumination which he has poured into our minds, it acknowledges with profound humility, that our light at last ends in darkness—that none by searching can fully find out God—nor comprehend the Almighty unto perfection, for it is higher than heaven what canst thou do, and deeper than hell what canst thou know!

Phrenology then stands, exactly like the other sciences of observation, upon the basis of phenomena, and their observed correspondence with a theory which is deduced from them. The mental energy of Gall, of Spurzheim, of Combe, and of many other philosophers of high intellectual powers and wide observation, has been, through many years, directed to the investigation, and they have declared, that they find a prevailing correspondence between the size and conformation of the brain and of the cranium, and the energy of the intellectual faculties, moral sentiments, and animal propensities of man.

As it is a fair pursuit—a legitimate branch of physical, mental and moral philosophy—let it then have free scope, until additional observations through a wider range of time, and made by many other men, equally or even better qualified for the investigation, shall either establish or overthrow its claims.

This apologetic plea for phrenology has been thrown in, not because we have made up our minds *to go for the whole*, but because we would strenuously maintain the liberty of free investigation. Philosophical is as sacred as civil and religious liberty, and all three are indispensable to the perfection of man's faculties, to the improvement of his condition, and to the just comprehension of his duties. In suggesting the considerations that have been presented, we do not assume or deny that the minute divisions of the mental, moral, and animal faculties indicated by phrenology, as the science is now taught, are all fully made out. On this question we would not hazard an opinion, for here phrenology would demand a trial by its peers—by a jury of superior minds, qualified to decide by their acumen, their general knowledge, their large observation on this subject, and their strict logical discipline; but all intelligent and candid persons can judge of the general correspondence of the theory with the phenomena; they can observe that there is an intellectual, a moral, and an animal conformation of the head, which, as the one region or the other prevails, greatly influences the character and conduct.

This general development, this characteristic conformation, we think is clearly discernible when we examine many individuals; it is therefore, this leading revelation of mental power, of moral affections, and of animal propensities, which we believe that Gall, Spurzheim, and Combe, and other able and enlightened phrenologists, have it in their power to indicate, with a prevailing certainty, sufficient to justify particular courses of treatment with the insane, with felons, and (with great care and prudence) even with pupils and children.

If then we are right in this conclusion, phrenology does not deserve the sneers, the ridicule and contempt of which it is still made the theme; nothing is easier than to cherish our own self-esteem by indulging in such cheap effusions of self-complacency; and to guard against any possible verdict of credulity, by an early vindication of our superior sagacity in foreseeing the *reductio ad absurdum*, which those who predict such a result will be very prone not only to expect but to desire. Many excellent people, with the best moral and religious feelings, are often alarmed by the discoveries of science; we do not speak of science, "*falsely so called*," but of real science, which is only another name for truth. Truth is the noblest attribute of the Creator himself; we are too apt to forget that it is as distinctly recorded in his works as in his word, and if we would know what he has revealed for our instruction, we must faithfully read and understand the volume of creation, as well as that of revelation; both are his work; both are true, and both are worthy of our most assiduous study. We fail, therefore, in moral courage, if we fear to advance in the ways of truth, and to follow where she leads, whether in nature or in revelation.

Every important science has at first been received with scepticism, if not with obloquy, contempt, or hostility.

Astronomy, assailed by ignorance and bigotry, long maintained a defensive attitude against the civil and ecclesiastical powers of that age, which boasts a Galileo, a Kepler, and a Newton; but for almost two centuries, this, the noblest of the physical sciences, has been fully victorious.

Geology has sustained a warfare of many years, but having vindicated her cause, begins to feel assured of permanent peace.

Phrenology is still marching in an enemy's country, and the issue may appear more doubtful; but we are assured by her learned professors, that she is gaining efficient allies, and every year increasing in power.

We have appeared in the field as mediators, not as belligerents on either side, but hoping to recommend a suspension of hostilities preliminary to an amicable and fair discussion of the points at issue, in the confident hope that a permanent and honorable pacification may be the result, and that all the parties in the controversy, having defined the boundaries of their respective dominions by more exact limits and more durable landmarks, may find in the end, that the independence of each is more fully established, while all the members of the alliance are bound more firmly together than ever, by a consistent and harmonious efficiency, as beneficent in its influence as it will be delightful to every truly enlightened and philanthropic mind.

New Haven, March 31, 1840.

Art. XI.—*Table showing the First Appearance of Ice, the Closing and the time of Opening of the Connecticut River at Middletown;* by Joseph Barratt, M. D., corresponding member of the Academy of Natural Sciences of Philadelphia, and of the New York Lyceum of Natural History, &c. The latitude of the Wesleyan University in Middletown is 41° 33′ 8″ N. Longitude 4h. 51m. 2s. = 72° 45′ 30″ W.

To the Editors of the American Journal of Science and Arts.

Gentlemen—The annexed table is submitted to your examination, and if considered of sufficient value to be entitled to a place in the Journal of Science and Arts, I shall be happy to see it in print. I have thought this table might not be without its interest to those engaged in the navigation of the Connecticut river, as it will furnish them with data for sixty years, of the closing with ice, and the periods of opening at Middletown, situated thirty miles from its mouth. I am not aware that any similar table relating to the Connecticut river, has ever been given to the public. The Regents of the University of the State of New York, have considered the "periods when the Hudson river is opened and closed at Albany," of sufficient importance to be printed in their annual reports, made to the legislature of that State, see Document No. 56, p. 206, for 1839. The dates there referred to, commence in 1786, but the table is incomplete till the year 1818, when the *opening* as well as the period of the closing of the Hudson river, is given. This table may also be serviceable to the geographer desirous of ascertaining the periods the great rivers of North America continue ice-bound, and for comparison with the rivers and climate of the north of Europe.

Middletown, Conn., February 24, 1840.

Winters.	First appearance of ice in the river.	Obstructed or closed.	Open again.	Ice gives way.	Open for navigation.
1635		Dec. 25 N. S. 15 O. S.			
1762				March 25	April 6
1763				1763, March 26	
1779		Dec. 8		1779, Feb. 15	
1780		Dec. 4	Dec. 12	1780, March 8	March 18
1781				1781, March 7	March 13
1781	Open.			1782	March 12
1782		Jan. 5	Jan. 15		
1782	Dec. 9	Dec. 14	Dec. 28		
1783	Nov. 24	Dec. 24	Dec. 1	1783, Feb. 17	March 16
1784		Dec. 22		1784, March 15	March 24
1785	Dec. 2	Dec. 27	Dec. 5	1785, April 2	April 7
1786	Nov. 24	Nov. 27		1786, March 7	March 15
1787	Dec. 11	Dec. 14		1787, March 13	March 20
1788	Dec. 5	Dec. 17	Dec. 7	1788, March 14	March 22
1789	Dec. 13		Dec. 19	1789, March 14	March 27
1790	No record.				
1791		Dec. 10		1790, Feb. 25	March 4 and 19
1792		Nov. 24 Dec. 10	Nov. 28	1791, March 11	March 22
1793	Dec. 5			1792, March 13	March 18
				1793, Feb. 27	March 18
1794	Open.			1794, March 15	
1795		Jan. 5		1795, March 7	
1797		Nov. 28		1797, Feb. 10	Feb. 22 March 15
1798		Jan. 15		1798, March 17	
1798	Nov. 22	Nov. 26 Dec. 6	Dec. 1	1799, March 22	
1799	Dec. 9	Dec. 13			
1801		Dec. 16		1801 Jan. 2 Feb. 27	
1802		Dec. 13	Dec. 29	1802, Jan. 8	Jan. 11 Feb. 16
1803		Dec. 23	Dec. 30–31	1803, Feb. 7	Feb. 19
1804		Dec. 10		1804	March 26
1805		Open.		1805, March 7	
1806		Jan. 9		1806, Feb. 19	Feb. 24
1806	Dec. 6	Dec. 8			
1807	Nov. 20	Open.		1807, March 10	March 18
1808		Jan. 2		1808 Feb. 3 March 1	March 2
	Dec. 15	Dec. 16	Dec. 19		
1809		Jan. 2		1809, March 21	April 1
		Nov. 24	Dec. 2		
1810		Dec. 13		1810 Jan. 1 Feb. 20	March 5
1811	Dec. 15			1811	March 22
				1812, Feb. 9	
1815		Dec. 12	Dec. 24	1815, March 9	
1816		Dec. 6 and 17	Dec. 13 and 28	1816, March 2	March 14
1817		Dec. 23			
1818		Dec. 12		1818, March 3	
1819		Dec. 11		1820, March 19	
1821		Dec. 15		1821, March 10	
1822				1822, March 4	
1823		Dec. 9		1823, March 12	
1824	No record.				

Winters.	First appearance of ice in the river.	Obstructed or closed.	Open again.	Ice gives way.	Open for navigation.
1825		Dec. 13		1826, Jan. 1	March 7
1827		Dec. 23			
1828		Dec. 31		1828	Jan. 15 Feb. 7
1830		Dec. 22		1830	March 9
1831		Dec. 2			
*1832	Dec. 21	Dec. 22		1832, March 5	March 10
*1833	Dec. 13	Dec. 14		1833, March 19	
*1834	Dec. 14	Dec. 15		1834, Feb 16	Feb. 26
*1835		Nov. 29		1835 Jan. 29 Mar. 13	March 16
*1836	Nov. 28	Dec. 2	Dec. 11	1836, March 28	April 2
*1837		Jan. 1		1837, March 15	March 23
	Dec. 9	Dec. 15		1838 Jan. 4 Mar. 12	Jan. 5 March 17
*1838	Nov. 25	Nov. 27			
*1839	Nov. 23, clear again till Dec.16	Dec. 17	Dec. 1, no ice till Dec. 16	1839, Feb. 27	March 1
				1840, Feb. 19	Feb. 22

Notes and occurrences.—1635, see Gov. Winthrop's Journal, 2d ed., Vol. I, p. 173. 1780, a severe winter. 1785, good sledding on the river March 24. 1786, thirty to forty vessels froze in the river preparing for sea in November. 1790, mild winter. 1801, great flood twenty one feet three inches above low water mark March 21. 1802, mild winter. 1810, mild winter. 1816, river opens and shuts again twice. 1818, the ice carried away Hartford bridge, and Rand's store at Middletown. 1824, mild winter. 1828, mild winter. 1832, steam boat Victory detained at the wharf one hundred days in the ice. 1837–8, mild winter. 1839, great flood eighteen feet above low water mark; Jan. 28, part of Hartford bridge carried away. 1840, a severe winter—navigation in the sound closed.

The dates from 1832 marked * are from the observations recorded by J. B.; the rest have been drawn from authentic sources. There are some years of which no record could be obtained.

Art. XII.—*Applications of the Igneous Theory of the Earth;* by Prof. J. H. Lathrop, of Hamilton College, Clinton, N. Y.

In accounting for the secular changes of magnetic polarity on the principles of the prevailing geological theory, I attempted to show in Art. XI, Vol. xxxviii, p. 68, that the igneous theory involves, as a necessary physical consequence, a more rapid revolution of the earth's crust than of the central fluid. The same reasoning applies to all the concentric spheres into which we may suppose this fluid to be divided. Whatever the law of contraction may be, the acceleration of the diurnal velocity increases from the centre outward. We have here, very obviously, the foundation laid for unremitted and not irregular changes of contact of the particles of the fluid mass with each other, and with the internal surface of the crust. Must not these extensive and systematic changes of contact result in the regular development of the galvanic agent? I propound this question for the consideration of those who ascribe the polarity of the needle to the regular action of electro-magnetic currents.

I proceed now to the statement of some other physical consequences of the geological theory, which appear to me to be interesting in themselves, and which may, by possibility, have some bearing on the diurnal and annual irregularities in the declination of the needle.

Modern science has demonstrated that the form of the earth is that which would be assumed by a fluid mass of the same magnitude, and revolving with the same velocity. The surface of the ocean at rest and uninfluenced by the heavenly bodies, is a continuous portion of the spheroid. Continents and islands are portions of the crust which rise above the oceanic surface at every variety of elevation within the perpendicular of about five miles. There is no good reason to doubt that the submarine valleys descend below the surface to every degree of depression within a still greater perpendicular—greater in the ratio which the oceanic surface bears to the continental surface at the same level.

These irregularities which obtain on the earth's surface are such as the geological theory would lead us to anticipate in consequence of the gradual contraction of the internal fluid, the occasional disruption of the primitive crust of the spheroid, and the arrangement of the fragments on statical principles. Indeed, the geologist must look upon the deep bed of ocean and the emerging continent, the mountain range and the river basin, the alternations of hill and dale resting on strata variously inclined, as the *rugæ* of an envelope now too large for the ball it encloses. He can hardly fail to perceive, that if the crust were distended to its original position by enlarging the volume of the mass within, these inequalities would in the main disappear.

We are not, then, in the light of the geological theory, to consider the crust of the earth as a continuous, entire and self-sustained shell; but as composed of the fragments of the primitive envelope of the spheroid, floating on the central fluid, and resting against each other at their elevated angles. Continents are the result of such a statical disposition of a congeries of larger fragments; while minor combinations of masses mutually inclined present us with islands or submarine mountains, according to their elevation relatively to the oceanic surface. These inclined portions of the earth's crust, resting on the central fluid of greater specific gravity than themselves, and pressed firmly together at their lower angles by their own weight, constitute the bed of ocean and the principal marine divisions.

If these are legitimate deductions from the geological theory, it is manifest that by virtue of the gradual contraction of the central fluid, the inequalities of the earth's surface are from age to age increasing; that in the gross, the elevation of continents and islands above the surface of the ocean is gradually becoming greater; that the land is encroaching upon the water, or in other words, that the level of the sea is from time to time assuming a lower position with reference to fixed points on the shore. I say in the gross, for partial causes may operate to vary the result in particular cases; and even extensive lines of coast may be so situated as to exhibit the contrary phenomenon. On the principles of the theory, however, the general rule must be as stated. Indeed, in view of the local evidences of this recession of the waters, nothing is now more common with the geologist than to assign, as a cause of the phenomenon, the "upheaving" of the contiguous portion of the earth's surface. These are but particular cases under the general law. By way of illustration we may refer to those islands whose soil rests on a continuous substratum of coral. Now it is well known, that the coral formation is of submarine origin, and its appearance above the surface can be accounted for only by the "upheaving" of the apex of the submarine mountain on which its *growth* took place.

The fragmentary character of the earth's crust would seem to be strongly attested by the phenomena of earthquakes. These phenomena, in all their extent and variety, are wholly irreconcilable with the supposition that the structure of the earth is solid throughout. And adopting on the other hand the hypothesis of an unbroken and sulf-sustained shell, enclosing a central fluid, it would be difficult to avoid the conclusion that all earthquakes must be universal in their extent. Physical action commencing in any part of the shell, could hardly fail to send its vibrations through the whole. It is matter of experience, however, that these phenomena are not thus universal. Some are of comparatively small extent, while others affect considerable portions of the earth's surface. The geological theory suggests the following solution of the difficulty. The internal expansive agent, finding too tardy a discharge through its ordinary channel, the volcano, expends its force in elevating the fragments of the crust directly over it. The agitation may be confined to the single fragment, or it may be extended to the contiguous group. By way of illustration, we may apply this mode of accounting for these convulsions of nature to the case of the sudden and simultaneous recession of the waters from the shores of the Sandwich Islands, followed by the return current a few minutes after, occurring in 1819, and again in 1837. The supposition of a slight rising and falling of that fragment of the earth's crust on which this group is situated seems to account fully for the phenomena, apparently incapable of explanation on any other hypothesis.

If the earth's crust is thus fragmentary, it is obvious, that in the gross, it accommodates itself to the form of the internal fused mass on which it rests, namely, the spheroid of revolution. And not only so, but this envelope presents no immovable obstacle to any periodical changes of form which the central fluid may be disposed to undergo. The upper and lower angles of the fragments are the joints of the *testudo;* and a very slight play of these would be sufficient for all the purposes of accommodation.

The Newtonian theory of the tides has a very imperfect application to a superficial fluid like the ocean, of limited depth, and broken by continents and islands. It requires for its perfect exemplification a spheroid of revolution fluid to the centre. Precisely such a spheroid is that which the geological theory supposes to be enclosed within the crust of the earth; and as has been shown, this crust presents no barrier to the action of the sun and moon in accordance with the Newtonian theory. It would seem to be a legitimate conclusion from these premises, that the central fluid is subject to tides, recurring at any given point twice during each lunar day, a period of about 24h. 50m.; and it must be further admitted, that there is a constant play of the fragments of the earth's crust, in accommodation to these diurnal changes of form in the central fluid.

Can we have proceeded thus far in our speculations, without being prepared to admit that the oceanic tides, instead of being the direct result of the action of the sun and moon, in accordance with the Newtonian theory, are but a secondary effect—in part at least, a consequence of the tides which must prevail in the central fluid, if the geological theory be true. It is quite manifest that the undulations of the earth's crust would produce a regular ebbing and flowing of the sea, without reference to the direct action of the sun and moon on the waters of the ocean. While a line of coast is rising to its maximum height, the oceanic tide is ebbing towards low water mark; and when the coast falls to its lowest position, the oceanic tide is at flood.

If this modification of the Newtonian theory of the tides be founded in truth, it is but fair of course to expect, that in its applications it will be found to explain facts which have admitted of no satisfactory solution hitherto. By way of illustration, I will state one of these applications. On the line of our coast generally the high tides are from four to six feet above the level of low water. Proceeding however along the coast east of the Piscataqua, we find a tide of eight or nine feet at the mouth of the Kennebec; of twelve or fifteen at the Penobscot; of twenty or twenty five at Passamaquoddy; while at the eastern extremity of the Bay of Fundy, the rise is from forty to sixty feet. Now I would ask whether this phenomenon is at all reconcilable with the hypothesis that the bed of the ocean is immovable. Why should the tides in the Delaware and Chesapeake bays become less and less as we leave the open sea, while the rise in the Bay of Fundy increases to this extraordinary degree as we proceed inland?

Let us apply the geological theory to the solution of this question. It is very generally true that the slope, which by dipping below the surface of the ocean forms a line of coast, has its upper termination in a range of mountains parallel to the coast. Thus it is with the eastern slope of the Alleghanies forming our Atlantic coast. It is obvious from the bare statement, that in this and like cases, the play of the fragment of the earth's crust constituting said slope must be such, that the tides in bays and estuaries will diminish as we proceed inland. A different geological arrangement prevails in New England, the line of coast being nearly perpendicular to the mountain ranges. It is obvious, then, on inspection of the map, that the undulations of that fragment which embosoms the Bay of Fundy would be likely to be such as alternately to elevate and depress the eastern extremity of the bay more than any part of the line of coast west of it. A strong current, therefore, setting down from the ocean into the bay, must prevail during the six hours of depression ; and an equally strong current setting down from the bay into the ocean, must prevail during the same period of elevation. Granting these conditions, we should be authorized, on the principles of hydrodynamics, to expect tides of extraordinary height at the eastern angle of the bay, and that a reflex influence would be experienced along the line of coast westward. Were the position of the Bay of Fundy reversed, so that it should open easterly into the Atlantic, all that is extraordinary in the phenomenon we have been considering would probably disappear.

The possible bearing of our argument on the subject of magnetic polarity, is sufficiently obvious. If the magnetic line at any given place is the resultant of all the magnetic influences in the body of the earth, then whatever cause affects the figure of the earth will affect the position of the magnetic line. Whatever the causes of the subordinate oscillations of the needle may be, it is not doubted that they are connected with the diurnal and annual motions of the earth. Admitting then the existence of internal tides, there is no absurdity in the supposition, that the distribution of the magnetic influences may be so far affected by them as to impart to the needle a sensible irregularity, whose period shall be a lunar day, and whose amount shall vary monthly and annually, according to the different relative positions of the moon, the sun, and the earth. It may not therefore be a matter devoid of interest, to settle by accurate observation, whether the minor oscillations of the magnetic line be or be not connected, in any degree, with the lunar motions.

Hamilton College, May 10, 1840.

Art. XIII.—*Notice of " Third Annual Reports on the Geological Survey of the State of New York, to the Assembly, Document* 275, *Feb.* 27, 1839;" by Oliver P. Hubbard, M. D., Professor of Chemistry, Mineralogy and Geology in Dartmouth College, New Hampshire.

The Report of 1838 received an extended notice in this Journal, Vol. xxxvi, p. 1, in which the results of the labors of the geologists were fully exhibited. The Report of 1839 need not therefore be so minutely examined—and as that for 1840 is soon to be published, we hope that the whole survey will now be digested by the several geologists into one comprehensive work, with drawings, sections, and figures, fully illustrating the geological structure and fossil geology of this extensive territory.

Prof. Beck has given a *Tabular View of the Minerals of the State*, comprising 132 species, many of which are among the most beautiful crystallized specimens with which our cabinets are furnished. Many are among the highly useful minerals; but of *anthracite*, the existence of which in large deposits has seemed a desideratum, only very small quantities are found, and the examinations have shown there is no longer reason to hope for its occurrence, as in the adjacent state of Pennsylvania, the rocks of New York all lying beneath the regular coal series of Pennsylvania. On the other hand, gypsum, in all its varieties, is found in such extensive deposits, and so accessible by the Erie canal, that as an article of home consumption, and of export, it bids fair to give a permanent prosperity to the agricultural interest. So important has a union between the interests of the two states, based upon the coal and gypsum, been viewed, that a committee of the legislature of Pennsylvania was sent to the legislature of New York, proposing, by the construction of a canal connecting the interior of both states, an interchange of these commodities for their mutual benefit.

Sulphur has been found in a pure form, in granite and quartz, near West Point, and occasionally in the gypsum beds of Onondaga County, and as a deposit from the sulphur waters. These springs, impregnated with the sulphuretted hydrogen, are described as very numerous, not less than a hundred.

The *white* and *gray* primitive marbles, and the black and gray of the transition, beautified by the various organic remains, afford varieties sufficient to meet the public taste in ornamental architecture.

The *hydraulic limestones* of this state are of great value and abundant. Those who recollect under how great a pressure of public opinion, favorable and adverse, the construction of the Erie Canal was decided upon, to commence with the middle section, from a little east of Utica to Syracuse as the cheapest part, will regard the early discovery of water lime on this section as having been of very great moment to the completion of the whole work, in supplying the material for laying the numerous locks and aqueducts throughout its whole length.

Analysis and experiments with natural and artificial water cements, have thrown such light on the subject that the arts need not suffer from ignorance in their application, and analysis should be held necessary, and perhaps actual trial, to determine the value of a supposed water limestone. Dumas (Chimie Appliqué aux Arts) gives the following general results concerning limes, as ascertained by Berthier, Vicat, and John.

1. That limestones almost pure always produce a lime that like clay, forms a paste with water; and 2. Limestones of complex composition, but containing no argile, produce a lime that does not form a paste with water, and is not hydraulic. When a limestone of the first class contains 90 per cent. of pure lime, 10 per cent. of magnesia, silica, alumina or oxide of iron together, hardly alter its properties. When the magnesia rises to 20 or 25 per cent., the lime acts with water like class No. 2, and is not particularly hydraulic. Vicat asserts, that when it rises to 30 or 40 per cent. it communicates the hydraulic property. The hydraulic property has at one time been attributed to the ox. iron, at another to the ox. of manganese, and to each of the foreign earthy ingredients. Berthier finds by analysis of hyd. limes that one with 9 to 10 per cent. of argile is moderately hydraulic, and eminently with 20 to 30 per cent., but he thinks equal parts of alumina and silica are best. Finally: 1. Alumina alone is no better than magnesia alone. 2. Silica is the principal element, as no compound without this is hydraulic. 3. Ox. iron and manganese are usually without influence. 4. The union of silica, lime, and magnesia, or alumina, forms the best hydraulic limes.

The analysis of several *hydraulic limestones* by Dr. Beck, gives from 12 to 18 per cent. of magnesia. The profitable manufacture of magnesian salts is suggested from the serpentine and magnesian minerals of Staten Island, of some of the river counties above New York, and from the deposits in St. Lawrence County.

Native iron is recorded from two localities, viz. Burlington, Otsego County, a specimen of which is in the museum of the Albany Institute, and Penn Yan, Yates County, a specimen of which contained a minute portion of carbon, but no nickel, or cobalt.

The opinions concerning the age and place in the general series occupied by the rocks of central and western New York, have been at variance. They have been alternately described as transition and secondary; again the saliferous group is counted as above the coal series, and this, with the sandstone of Rochester regarded as the "new red;" and "the rocks of the 4th district are considered (Report for 1838) as belonging to the old red sandstone and the carboniferous groups, and to be above the Silurian system of Mr. Murchison," a conclusion "based in part upon the organic remains." The gradual and imperfect development of Murchison's labors before the publication of his work on the Silurian system, afforded few exact means of identifying distant strata, but since his magnificent work is now in our hands, an extended comparison by Mr. Conrad* of the organic remains of the New York rocks, has enabled him to class them as equivalents of the Silurian, and the rocks from the Trenton limestone to the Moscow shales and the sandstone and shales of Cazenovia inclusive, he identifies as members of this system, and he finds, as at Blossburg, Tioga County, Penn., the old red sandstone in its proper position between the coal and Silurian rocks, of the same color and character, mineral and *fossil*, as that of England, while some of the earlier rocks on the Hudson and Mohawk are regarded as equivalent to the Cambrian. Should this classification be sustained, it is very desirable that in the summary of the work some systematic or uniform nomenclature of the rocks should be adopted.

The palæontologist, Mr. Conrad, describes several new species of fossils, and as the names of some of the genera are new to many American readers, the reasons given for their use by Murchison, Part II, p. 643, are here extracted.

"The generic names of *Leptæna*, *Atrypa*, and *Orthis*, being new to English geologists, their use on this occasion, demands an explanation. They are in fact, subdivisions of the great family of *Terebratula*, which, having been established by Dalman, have been since adopted by many foreign authors; and Mr. J. de C. Sowerby gives the following reasons for sanctioning their introduction among us.

"The generic names *Leptæna*, *Atrypa*, and *Orthis*, have been adopted from Dalman's memoirs in the *Stockholm Transactions*,

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* See this Journal, Vol. XXXVIII, p. 86.

in deference to the opinion of that author. The first of these synonyms (derived from λεπτος) stands in the place of Producta or Productus, a name to which grammarians have objected.

"The second genus, *Atrypa*, (from α privative, and τρυπα,) is divided from *Spirifer*, and includes those species which have a short hinge line without a large area, and are either destitute of a foramen, or possess only a small triangular one. They are rounded shells, and are not furrowed like the typical species of Spirifer; the internal spiral arms are preserved in some species. *Atrypa affinis*, and similar striated shells, would form another natural group, in which the internal structure, as well as the general form, is different; for the spiral appendages, if ever they possessed any, do not appear to remain; and there are two short crenated teeth in the hinge. The species of this division have generally been described as *Terebratulæ* by British authors, but they have acute, not perforated beaks.

"The genus *Orthis* (ορθος) is another division of *Spirifer*, no species of which has heretofore been described in England; it is distinguished from *Spirifer* by the long narrow hinge and circular flat form of the striated shells.

"Our genus *Pentamerus* is called *Delthyris* by the Swedes, but we see no reason for altering the name. If we were well assured of the stability of the genus *Delthyris*, we should remove to it *Atrypa galeata*, and perhaps one or two other species of *Atrypa*."

In the survey of the first district, the trap region of Rockland Co. is described as forming a narrow belt, the Palisades, along the Hudson River, from the N. Jersey line to near Haverstraw, thence it ranges off to the northwest, then west, and finally southwest, near the base of the Highlands, and disappears. A branch of it strikes off westerly, about two miles north of Nyack, towards the Highlands. These ranges are from a quarter to two miles broad, and on the east and north present mural columnar escarpments from three to eight hundred feet high, with the usual debris at the base; and the south and west sides usually slope off more gradually. The sandstone beneath is cut through by large and small dikes, and its layers are separated by lateral intrusions of trap. The trap varies from coarse crystalline to very compact greenstone, and from slaty clinkstone to a coarse amygdaloid. The sandstone presents a great variety of color, and of aggregation, and is frequently much altered in the vicinity of trap rocks. It affords superior hearth-stones for furnaces, and is employed as a flagging stone, and somewhat for cutting. A red calcareous marl is associated with it, and a gray limestone in beds from one to eight feet thick, affording good building materials and for lime.

The "red conglomerate limestone" occurs at or near the junction of the red sandstone formation with the primitive rocks, and is composed chiefly of pebbles and angular fragments of gray and black limestone, (like the adjacent primary limestone,) mixed with pebbles of quartz, granite, gneiss, hornblende, sienite, &c., cemented together by a reddish argillo-calcareous paste, mixed with gravel and sand of the same materials.

The general aspect is like the Potomac marble, and like this would be very desirable for ornamental purposes, except that the heterogeneous nature of its ingredients prevents their receiving a uniform polish. This rock seems to skirt the sandstone on its north edge, and presents us the indiciæ of the violent agencies that have formerly conflicted, and appears as not an unapt emblem of a fierce border war, in which the weaker party has left on the field the greatest number of slain.

Dr. Wm. Horton, as assistant, surveyed Orange Co. His observations upon the mineralogy of this region are well known. The white limestone, remarkable for its interesting minerals, is traced in short and broken ledges in granite, from the Hudson near Fort Montgomery, in deposits a few rods in width; again it occurs interstratified with the granite and hornblende rocks, and a mile wide; and again at intervals, "crosses the Ramapo by the east side of the Dutch Cedar Pond to the New Jersey line," about twenty miles, bearing southwest and northeast. It is coarsely crystalline, forming a handsome calc spar, white and red, and every where contains brucite, black spinelles, pargasite, sahlite, coccolite, crystallized augite, scapolite, zircon and sphene, serpentine and plumbago. It is often intersected by trap dikes, as at Dutch Cedar Pond, where there are three, one of which is a perfect greenstone, running east and west, and is seen cutting the limestone perpendicularly for 50 feet. At the inlet of Popelos Pond, the limestone forms a natural bridge, with its arch sustained on one side by hornblende rock, and on the other by granite. (?) More extensive deposits of a similar limestone occur in Warwick, passing near Goshen line into New Jersey, by the drowned lands on the west, and between mounts Adam and Eve. It contains beds of granite, quartz, hornblende, and augite rock, and is unstratified. The minerals found in this are similar to those enumerated above, and they are among the riches of American cabinets.

The Island of New York, as described by Dr. Gale, contains elevated ranges of granite and gneiss with imbedded rocks, a limited range of limestone on the north, while the southern portion is covered with "from ten to eighty feet of diluvium, resting on the same or greater thickness of alluvial or tertiary sands, which last are highly stratified and even exhibit the appearance of ripples as from the retiring waves of the ocean."

The most interesting portion of the report is that describing the bowlders and diluvial scratches. The *bowlders* are found in the greatest profusion and variety, and consist of *greenstone* in abundance—a rock that is not found in place on the island, nor nearer than the Palisades of New Jersey on the west, or on the east than Southbury, Conn., and the ranges of Connecticut River valley that terminate at New Haven. There can be little doubt that they came from New Jersey, in accordance with the general evidence of a current from the N. W. to the S. E., and yet although they have passed but this short distance, they are always rounded and covered all over with grooves and scratches. They are from ten to fifteen feet in diameter. In many parts of the city they have been removed by the process of grading the streets; but in the front of Brooklyn heights, they may be seen in great numbers, when excavations are made for erecting buildings. Others are of

Red sandstone, a rock not found in the island, but limited to the same localities above named, underlying the trap.

Serpentine, of Hoboken, particularly in the south part, and at Corlaer's Hook and Brooklyn.

White limestone, as from Kingsbridge.

Granite and gneiss, as abundant as greenstone, in every portion except the north extremity of the island. Those from ten to twelve feet in diameter are common, and one of granite, eleven feet diameter, "near Manhattanville, on the Bloomingdale road, rests on the gneiss," which is covered with diluvial grooves, and a very large one, three inches deep and eighteen inches wide, between the road and the bowlder, and terminating at the bowlder, seems to have been caused by the movement of this huge mass."

Hydrous anthophyllite rock,* that exists in place on the west side of the island, lying between the granite and gneiss, is found in bowlders of large size, extensively diffused. Some of them are fifteen feet, ×12×6; 13×8×7, and are even distributed over the adjacent parts of Long Island.

" The direction of the current" that carried these, " is ascertained by the grooves and scratches left on the solid rocks, and its force, by the size and quantity of the fragments, and the distance and elevations over which they had been transported." The furrows are visible, wherever the rocks are uncovered, " on the highest rocks and at the lowest tide-water mark, a difference of more than one hundred feet in perpendicular height, always more strongly marked on the northwest slopes of the hills, than on the southeastern—often very distinct on the west and northwest slopes, extending to the highest point of the rock, and no trace of them on the south and southeast slopes, although both surfaces are equally exposed. From observations made in sixty to seventy places, the general course of the current rises from N. 45° W., with extreme variations of 23°, coincident with the direction of the furrows found on the greenstone across the river in New Jersey.

The present position of the bowlders of anthophyllite and limestone, indicates a deflection of the current S. and S. S. W.

The size of the furrows is very various and of some remarkable, ranging from a line in width, and eighteen inches wide by four deep, to troughs of two feet in width by six to eight deep, as may be seen on the 8th avenue, between 79th and 81st street, and at one locality on the Hudson, six miles from the city, " furrows ascend from beneath the lowest tide-water, up an elevation of seventy feet in three hundred or four hundred feet distance."

The portion of the 2nd district surveyed by Prof. Emmons, seems rich in resources, as marbles, porcelain and other clays, peat, graphite, and iron ores. This section, including the unsettled portion of Herkimer, comprises nearly one fourth part of the area of the state, is chiefly a primitive country, and is like New England, in its geology, unequal surface, soil, climate and productions. Its highlands, the loftiest mountains of the state, are covered with most valuable timber, and the streams and rivers

* Commonly known as the radiated asbestus.

that rise in them, furnish an abundance of water power, and a very tolerable means of internal communication, and form on the levels, numerous transparent lakes, like those of New England, and particularly of its mountainous parts.

As yet civilization has not penetrated this extensive wilderness, although it has drawn its cordon of settlements around it, and the interior is still the resort of wild beasts, and its deep recesses are now trodden by the adventurous huntsman in his chase after the moose, deer and elk, and with his traps taking the bear, the wolf, and until within a few years, the beaver. It is a region of unsuccessful land speculation, a land where proverbially "there is no law," where more than once the silent and unsuspecting Indian trapper has fallen by the rifle of the crafty settler. It possesses great variety of beautiful scenery, its soil under judicious husbandry, is capable of sustaining an immense population, and were it reclaimed by a hardy race of virtuous settlers, the time would not be distant, when it would be densely peopled by inhabitants possessing a character resembling that of New England as nearly as does its geology, and a kingdom would be added to the already powerful state of New York. Where so little strictly geological labor can be performed, the efforts of the geologist of this district to exhibit its capabilities of improvement are highly praiseworthy, and from his description of Hamilton Co., and from the accounts we have received of other parts from other sources, he is doing the community a great service, by calling public attention to it. If we may judge from the probable results, his labors here will rank in importance below those of no one of his associates.

The only remaining topic of the Report to which time will permit a reference, is that of the brine springs, &c. of Onondaga. Difficulties of such a nature attended their examination, that great obscurity surrounded the subject until recently. The numerous observations and theoretical discussions of Dr. Beck and of Mr. Vanuxem, the geologist of the third district, have now placed the subject in a clearer and more intelligible view. The relations of the rocks are thus described. Between the green shale of Herkimer and "the millstone grit" of Oneida, are found, between Utica and Rome, a series of rocks, called "the shales and green sandstone of Salmon river," and the red sandstone of Oswego, that cover a considerable portion of the north part of Oneida, the greater portion of Oswego, and the red sandstone covers a small triangle in the north part of Stirling, Cayuga County, fifteen feet above Lake Ontario, and rising with the other rocks going west, forms the lower falls of Rochester, nearly one hundred feet above that level.

This is followed by the *gray sandstone*, the same, in position at least, as "the millstone grit" of Oneida, and "the gray band" of Rochester. Then succeed the green shales, the iron ore beds, the calcareous "firestones," &c. &c., and lastly, the concretionary rock of Oneida, with shales and sandstone, the upper member of the "Protean group," passing from the low level near Oneida Lake west, forms "the upper falls of Rochester, the rock of the great excavation of Lockport, and the falls of Niagara."

The "red sandstone" of Oswego, is the lowest rock of Madison, Onondaga, and Cayuga, and "is the lowest rock, geologically, of New York, which contains brine springs of sufficient purity to be manufactured into salt." "From the east part of Oswego to Niagara River, numerous brine springs are found in this red sandstone, and all which occur in this rock in the third district, (and there are several in Oswego,) yield the same kind of sharp tasted salt, described as the saltpetre taste, and all highly colored with iron, characters different from the salt of the brine springs which belong to a subsequent deposit, and show a difference of source or contamination from being deposited with a different rock." The "*red oxide of iron*," the "lenticular clay iron ore," occurs in "two distinct beds in the Protean group, arranged in lines, parallel to each other, extending from Herkimer to the Genesee River, about twenty-five feet from each other, and from one to two and a half feet in thickness, not always present in every locality, one or the other, and even both being sometimes wanting.

The "red shale and the water limes of Herkimer and Oneida," or the "saliferous group of Onondaga" succeed, and consist of four deposits. First, or lowest, is the *red shale;* second, the lower gypseous shales, the lower part intermixed with red shale, which ceases with this mass; thirdly, the gypseous deposit, which embraces the great masses quarried for plaster, the hopper-shaped cavities, the "vermicular lime-rock" of Eaton, and other porous rocks; and fourthly, rocks abounding in groups of needleform cavities, placed side by side, caused by the crystallization of sulphate of magnesia, and which may be called the magnesian deposit. The gypseous and magnesian constituents excepted, the group consists generally of argillaceous materials in the lower part, and carbonate of lime in the upper part. "The red shale forms the base or lowest mass of the salt springs found along the course of the Erie Canal in the third district, and has often been confounded with the red sandstone of Oswego and its prolongation, the sandstone of Rochester and Niagara. The two rocks, being separated by the Protean group, have no connection with each other, nor resemblance, excepting that the same ferruginous material colors them both, and both are connected with saliferous sources." This rock "increases greatly in thickness" from east to west, and from a boring in Lenox of two hundred feet, just north of hills of shale two hundred feet high, attains here a thickness of four hundred feet, "yet no where has a fossil or a pebble been discovered in it, or any thing extraneous, excepting a few thin layers of sandstone and its different colored shales."

The second deposit is an alternation of variously colored shales, contains fibrous gypsum of a reddish or salmon color, and the excavations of wells exhibit the same products as are found in digging for salt water at Abingdon, Virginia, in a salt valley. No wells of water are obtained in this or the next deposit, on the hills, unless sunk below the level of the water courses, and therefore no brine springs could be found above this level, owing to the permeable nature of the strata. The only fossil is a small Cytherina.

The third or gypseous deposit, contains the extensive and valuable deposits of gypsum in insulated masses, never in layers and beds, in two distinct ranges, and separated generally by the "vermicular lime-rock of Eaton, the hopper-shaped cavities, and other porous rocks."

This group affords the only proof that *salt* has existed here in a solid state, though never has a particle been discovered in the rock, and it is the only known source of the brine springs of the district.

The vermicular rock is "a dark gray or blue rock, perforated every where with curvilinear holes, but very compact between the holes, some of them lined with a calcareous crust," and one of the porous rocks affording water lime, consists chiefly "of quartzose and carbonate of lime grains," and "passes into a porous cellular sponge-like rock, without carbonate of lime, but abounding in organic remains." "The cavities of these porous rocks have no analogy whatever with those derived from organic remains."

The rocks of the saliferous group resemble those in other countries near the deposits of fossil salt; the strength of the brine increases generally with the depth of the wells; "the soil in their vicinity is subject to those peculiar slips or sinkings which have also been observed in the vicinity of beds of rock salt," so common about the English salt deposits of Cheshire and Worcestershire, and the evidence is strongly corroborative of the theory that these brine springs (vide Vol. xxxvi) have their source in deposits of rock salt.

As has been stated, no rock salt has been seen; even those hopper-shaped cavities in no case contain the crystal, or model of salt, as it is believed to have been; and if the considerations above stated are sufficient to warrant the strong belief that the source of the brine springs in the alluvial beneath the bottom of Onondaga Lake *et aliis*, was the rocks above, there is still another that tends much to strengthen it. There is evidence of the removal of a soluble mineral from the rocks mentioned, on a very grand scale, (considering the extent of the formation,) and though the nature of the mineral does not appear with certainty, the only one that is found in solution, in relative quantity, is the salt. The brine is obtained in small quantities in the rock borings, but the valuable wells are found by borings made in the alluvial, in places of great depth, and scooped out by violent agencies, that removed the rocks and brought in the alluvial, and are now, in some cases, reservoirs of salt water below, and of fresh water in lakes above, with an intervening impervious stratum, preventing their commingling.

Were the vertical holes or pores of the vermicular rock, and the hopper-shaped cavities, and those in the other porous rocks, filled with rock salt, no hesitation would be felt in admitting the possibility of a supply of salt for brine springs in the lower rocks; and if in the absence of such evidence, any thing analogous were shown to exist in other saliferous formations, it would seem to explain and sustain the former supposed association of salt in the rocks.

In Murchison's Silurian system, p. 31, is a description of the "saliferous marls" of England, from which we learn that at Droitwich, though the brine springs have been in use since the time of the Romans, the rock salt was only discovered in 1828, and the section given of the saliferous marls at Stoke Prior, (from the pamphlet of Dr. Hastings,) shows not only an association of salt and gypsum as usual, but, what is of peculiar interest to our subject, the "red and green marl traversed by veins of gypsum, usually vertical, one hundred and ninety-five feet," and succeeded (series descending) by "red marl, containing 'rock salt,' nearly pure, distributed like the gypsum in the overlying mass," twenty-four feet, and by five layers of rock salt, and four others of "red marl with veins of salt," and all in the space of four hundred and sixty feet. If these marls have firmness enough to cohere, were the salt dissolved out by the surface waters percolating through the strata, they would present very similar phenomena to those exhibited by our porous rocks, which, however, have probably a firmer structure, and though some of the gypsum, by the same causes, would be removed, yet the quantities of each dissolved would be in a ratio probably not far from that of their solubility, or as one to two hundred, while the proportions found in solution in the brine springs, that have escaped decomposition, according to the analysis of several Onondaga springs, are about as one to thirty or thirty-five. In the saliferous group of Monroe and Ontario, "small particles and seams of gypsum still remain, scattered through the marl, in which there are the usual deposits of masses of this mineral. Owing to the usually soft nature of these rocks, they have been removed, as described in Onondaga, from extensive tracts, and the space has been filled with alluvium from more northern rocks, throughout Seneca, Ontario, Wayne, and Monroe counties, and the red shale therefore does not appear between Cayuga Lake and Genesee River, though in some places, the red color of the soil indicates its proximity. The theory of the formation of the salt and gypsum, and the indications of igneous agency suggested by the geologists, may more appropriately be referred to when we have their mature views. It would seem, however, that, with the coal formation of Pennsylvania at one extreme of the series, and the primary rocks of New York at the other, and the intervention of four thousand feet of strata between the saliferous group and the coal, and the discovery of the true old red sandstone in the series above the rocks of New York, and the coincidence of the organic remains of the New York rocks with those of the Silurian system, the proper geological relations and age of this group might be satisfactorily fixed and determined, and showing that it does not belong to the usual saliferous series, the new red sandstone. How far this is an anomaly may be judged from the facts, that in England, "neither rock salt nor salt springs occur in the middle or lower members of the new red sandstone; and hence the term 'saliferous,' as applied to the *whole* system, appears objectionable, since the marls in which the salt lies, constitute only the upper portion of the mass," considered "as the new red system." "In certain parts of Germany, salt appears to pervade the underlying bunter sandstein;" "in other tracts of central Europe, it abounds in tertiary strata, (Wielitzke, in Poland.) At Cardona, in Spain, it is found in rocks of the age of our green sand; in the Austrian Alps, it has been shown by Prof. Sedgwick and Murchison, to occur in limestone of the oolitic system; whilst in many countries, including England, saline springs occasionally burst out from the carboniferous and older systems of rock."—*Murchison, Silurian Syst. p.* 32.

The Report on the Geological Survey of N. York for 1839–40, being public document 50, came too late for notice in the present number.

Art. XIV.—*An answer to Dr. Hare's Letter on certain Theoretical opinions;* by M. Faraday.*

My Dear Sir—i. Your kind remarks have caused me very carefully to revise the general principles of the view of *static induction*, which I have ventured to put forth, with the very natural fear that as it did not obtain your acceptance it might be founded in error; for it is not a mere complimentary expression, when I say, I have very great respect for your judgment. As the reconsideration of them has not made me aware that they differ amongst themselves or with facts, the resulting impression on my mind is that I must have expressed my meaning imper-

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* Royal Institution, April 27, 1840.

Gentlemen—Can you add to the favors I am already under by inserting in your Journal my reply to Dr. Hare's letter addressed to me and published in your excellent work. I am, gentlemen, your obliged servant, M. Faraday.

To the Editors of the American Journal of Science and Arts.

fectly; and I have a hope, that when more clearly stated, my views may gain your approbation. I feel that many of the words in the language of electrical science possess much meaning, and yet their interpretation by different philosophers often varies more or less, so that they do not convey exactly the same idea to the minds of different men; this often renders it difficult, when such words force themselves into use, to express with brevity as much as, and no more than, one really wishes to say.

ii. My theory of induction (as set forth in series xi, xii, and xiii,) makes no assertion as to the nature of electricity, or at all questions any of the theories respecting that subject (1667.) It does not even include the origination of the developed or excited state of the power or powers; but taking that as it is given by experiment and observation, it concerns itself only with the arrangement of the force in its communication to a distance in that particular yet very general phenomenon called *static induction* (1668.) It is neither the nature nor the amount of the force which it decides upon, but solely its mode of distribution.

iii. Bodies, whether conductors or non-conductors, can be charged. The word *charge* is equivocal; sometimes it means that state which a glass tube acquires when rubbed by silk, or which the prime conductor of a machine acquires when the latter is in action; at other times it means the state of a Leyden jar or similar inductive arrangement when it is said to be charged. In the first case the word means only the peculiar condition of an electrified mass of matter considered by itself; in the second it means the whole of the relations of two such masses charged in opposite states and most intimately connected by inductive action.

iv. Let three insulated metallic spheres A, B, and C, be placed in a line and not in contact; let A be electrified positively, and then C uninsulated; besides the general action of the whole system on all surrounding matter there will occur a case of inductive action amongst the three balls, which may be considered apart as the type and illustration of the whole of my theory: A will be charged positively, B will acquire the negative state at the surface towards A and the positive state at the surface farthest from it, and C will be charged negatively.

v. The ball B will be in what is often called a polarized condition; i. e. opposite parts will exhibit the opposite electrical states and the two sums of these opposite states will be exactly equal to each other. A and C will not be in this polarized state, for they will each be as it is said charged (iii); the one positively, the other negatively; and they will present no polarity as far as this particular act of induction (iv) is concerned.

vi. That one part of A is more positive than another part does not render it polar in the sense in which that word has just been used. We are considering a particular case of induction and have to throw out of view the states of those parts not under the inductive action. Or if any embarrassment still arise from the fact that A is not uniformly charged all over, then we have merely to surround it with balls such as B and C on every side so that its state shall be alike on every part of its surface, (because of the uniformity of its inductive influence in all directions,) and then that difficulty will be removed. A, therefore is charged but not polarly, B assumes a polar condition, and C is charged inducteously (1483); being, by the prime influence of A brought into the opposite or negatively electrical state through the intervention of the intermediate and polarized ball B.

vii. Simple charge therefore does not imply polarity in the body charged. Inductive charge (applying that term to the sphere B and all bodies in a similar condition (v)) does (1672.) The word charge, as applied to a Leyden jar or to the whole of any inductive arrangement, by including *all* the effects, comprehends of course both these states.

viii. As another expression of my theory, I will put the following case. Suppose a metallic sphere C formed of a thin shell a foot in diameter; suppose also in the centre of it another metallic sphere A, only an inch in diameter; suppose the central sphere A charged positively with electricity to the amount we will say of 100: it would act by induction through the air, lac, or other insulator between it and the large sphere C; the interior of the latter would be negative, and the exterior positive, and the sum of the positive force upon the whole of the external sphere would be 100. The sphere C would in fact be polarized (v) as regards its inner and outer surfaces.

ix. Let us now conceive that instead of mere air or other insulating dielectric within C, between it and A, there is a thin metallic concentric sphere, six inches in diameter. This will make no difference in the ultimate result; for the charged ball A will render the inner and outer surfaces of the sphere B negative and positive, and it again will render the inner and outer surfaces of the large sphere C negative and positive: the sum of the positive forces on the outside of C being still 100.

x. Instead of one intervening sphere let us imagine 100 or 1000 concentric with each other and separated by insulating matter, still the same final result will occur; the central ball will act inductrically, the influence originating with it will be carried on from sphere to sphere, and positive force equal to 100 will appear on the outside of the external sphere.

xi. Again, imagine that all these spheres are subdivided into myriads of particles, each being effectually insulated from its neighbors (1679), still the same final result will occur; the inductric body A will polarize all these, and, having its influence carried on by them in their newly acquired state, will exert precisely the same amount of action on the external sphere C as before, and positive force equal to 100 will appear on its outer surface.

xii. Such a state of the space between the inductric and inducteous surfaces represents what I believe to be the state of an insulating dielectric under inductive influence; the particles of which by the theory are assumed to be conductors individually but not to one another (1669).

xiii. In asserting that 100 of positive force will appear on the outside of the external sphere under all these variations, I presume I am saying no more than what any electrician will admit. Were it not so, then positive and negative electricities could exist by themselves and without relation to each other (1169, 1177); or they could exist in proportions not equivalent to each other. There are plenty of experiments, both old and new, which prove the truth of the principle, and I need not go further into it here.

xiv. Suppose a plane to pass through the centre of this spherical system, and conceive that instead of the space between the central ball A and the external sphere C being occupied by a uniform distribution of the equal metallic particles, three times as many were grouped in the one half to what occurred in the other half, the insulation of the particles being always preserved: then more of the inductric influence of A would be conveyed outwards to the inner surface of the sphere C through that half of the space where the greater number of metallic particles existed than through the other half: still the exterior of the outer sphere C would be uniformly charged with positive electricity, the amount of which would be 100 as before.

xv. The action of the two portions of space, as they have just been supposed to be constituted (xiv), is as if they possessed two different *specific inductive capacities* (1296); but I by no means intend to say that specific inductive capacity depends in all cases upon the number of conducting particles of which the dielectric is formed, or upon their vicinity. The full cause of the evident difference of the inductive capacity of different bodies is a problem as yet to be solved.

xvi. In my papers I speak of all induction as being dependant on the action of *contiguous particles ;* i. e. I assume that insulating bodies consist of particles which are conductors individually (1669), but do not conduct to each other provided the intensity of action to which they are subject is beneath a given amount (1326, 1674, 1675); and, that when the inductric body acts upon conductors at a distance, it does so by polarizing (1298, 1670) all those particles which occur in the portion of dielectric between it and them. I have used the term *contiguous* (1167, 1673), but have, I hope sufficiently expressed the meaning I attach to it:— first by saying at par. 1615 "the next existing particle being considered as the contiguous one;" then in a note to par. 1665, by the words "I mean by contiguous particles those which are next to each other, not that there is no space between them," and, further, by the note to par. 1164 in the 8vo. edition of my researches which is as follows. "The word contiguous is perhaps not the best that might have been used here and elsewhere, for as particles do not touch each other it is not strictly correct; I was induced to employ it because in its common acceptation it enabled me to state the theory plainly and with facility. By contiguous particles I mean those which are next.

xvii. Finally, my reasons for adopting the molecular theory of induction were, the phenomena of electrolytic discharge (1164, 1343); of induction in curved lines (1166, 1215); of specific inductive capacity (1167, 1252); of penetration and return action (1245); of difference of conduction and insulation (1320); of polar forces (1665), &c. &c.; but, for these reasons, and any strength and value they may possess, I refer to the papers themselves.

xviii. I will now turn to such parts of your critical remarks as may require attention. A man who advances what he thinks to be new truths, and to develope principles which profess to be more consistent with the laws of nature, than those already in the field, is liable to be charged, first with self-contradiction; then with the contradiction of facts; or he may be obscure in his expressions and so justly subject to certain queries; or he may be found in non-agreement with the opinions of others. The first and second points are very important, and every one subject to such charges, must be anxious to be made aware of, and also to set himself free from, or to acknowledge them. The third is also a fault to be removed if possible. The fourth is a matter of but small consequence in comparison with the other three; for as every man, who has the courage, not to say rashness, to form an opinion of his own, thinks it better than any from which he differs, so it is only deeper investigation and, most generally, future investigators who can decide which is in the right.

xix. I am afraid I shall find it rather difficult to refer to your letter. I will however reckon the paragraphs in order from the top of each page, considering that the first which has its *beginning* first in the page. In referring to my own matter, I will employ the usual figures for the paragraphs of the experimental researches, and small Roman numerals for those of this communication.

xx. At par. 3, p. 1, you say you cannot reconcile my language at 1615 with that at 1165. In the latter place I have said, I believe *ordinary induction* in all cases to be an action of *contiguous* particles; and in the former, assuming a very hypothetical case, that of a vacuum, I have said nothing in my theory which forbids that a charged particle in the center of a vacuum should act on the particle next to it, though that should be half an inch off. With the meaning which I have carefully attached to the word contiguous, (xvi,) I see no contradiction here in the terms used, nor any natural impossibility, or improbability in such an action. Nevertheless, all *ordinary* induction is to me an action of contiguous particles, being particles at insensible distances; induction across a vacuum is not an ordinary instance, and yet I do not perceive that it cannot come under the same principle of action.

xxi. As an illustration of my meaning, I may refer to the case parallel with mine, as to the extreme difference of interval between the acting particles or bodies, of the modern views of the radiation and conduction of heat. In radiation the rays leave the hot particles and pass occasionally through great distances to the next particle fitted to receive them; in conduction, where the heat passes from the hotter particles to those which are contiguous and form part of the same mass, still the passage is considered to be by a process precisely like that of radiation; and though the effects are as is well known extremely different in their appearance, it cannot as yet be shewn that the principle of communication is not the same in both.

xxii. So on this point respecting contiguous particles and induction across half an inch of vacuum, I do not see that I am in contradiction with myself, or with any natural law or fact.

xxiii. Par. 1, page 2, is answered by the above remarks, and by viii, ix, x.

xxiv. Par. 2, page 2, is answered according to my theory by viii, ix, x, xi, xii, and xiii.

xxv. Par. 3, page 2, is answered, except in the matter of opinion (xviii), according to my theory by xvi. The conduction of heat referred to in the paragragh itself, will, as it appears to me, bear no comparison with the phenomenon of electrical induction:—the first refers to the distant influence of an agent which travels by a very slow process, the second to one whose distant influence is simultaneous, so to speak, with the origin of the force at the place of action:—the first refers to an agent which is represented by the idea of one imponderable fluid, the second to an agency better represented probably by the idea of two fluids, or at least by two forces;—the first involves no polar action, nor any of its consequences; the second depends essentially on such action;—with the first, if a certain portion be originally employed in the centre of a spherical arrangement, but a small part appears ultimately at the surface; with the second, an amount of force appears instantly at the surface, (viii, ix, x, xi, xii, xiii, xiv,) exactly equal to the exciting or moving force which is still at the centre.

xxvi. Par. 2, page 4, involves another charge of self-contradiction, from which therefore I will next endeavor to set myself free. You say I "correctly alledge that it is impossible to charge a portion of matter with one electric force without the other, (see par. 1177.) But if all this be true how can there be a *positively excited particle?* (See par. 1616.) Must not every particle be excited negatively if it be excited positively? Must it not have a negative as well as a positive pole?" Now I have not said exactly what you attribute to me: my words are, "it is impossible experimentally to charge a portion of matter with one electric force *independently* of the other. Charge always implies *induction*, for it can in no instance be effected without," (1177.) I can however easily perceive how my words have conveyed a very different meaning to your mind, and probably to others, than that I meant to express.

xxvii. Using the word *charge* in its simplest meaning, (iii, iv,) I think that a body *can* be charged with one electric force without the other, that body being considered in relation to itself only. But I think that such charge cannot exist without induction, (1178,) or independently of what is called the development of an equal amount of the other electric force, not in itself, but in the neighboring consecutive particles of the surrounding dielectric, and through them of the facing particles of the uninsulated surrounding conducting bodies; which, under the circumstances terminate, as it were, the particular case of induction. I have no idea, therefore, that a particle when charged must itself, of necessity, be polar; the spheres A, B, C, of iv, v, vi, vii, fully illustrate my views, (1672.)

xxviii. The third paragraph of page 6, includes the question, "is this consistent?" implying self-contradiction, which therefore I proceed to notice. The question arises out of the possibility of glass being a (slow) conductor or not of electricity; a point questioned also in the two preceding paragraphs. I believe that it is. I have charged small Leyden jars, made of thin flint glass tube, with electricity, taken out the charging wires, sealed them up hermetically, and after two or three years have opened and found no charge in them. I will refer you also to Belli's curious experiments upon the successive charges of a jar, and the successive return of portions of these charges.* I will also refer to the experiments with the shell lac hemisphere, especially that described in 1237 of my researches: also the experiment in 1246.

* Bibliotheca Italiana, 1837, LXXXV, p. 417.

I cannot conceive how in these cases the air in the vicinity of the coating could gradually relinquish to it a portion of free electricity conveyed into it by what I call convection, since in the first experiment quoted (1237), when the return was gradual, there was *no coating;* and in the second (1246) when there was *a coating*, the return action was most sudden and instantaneous.

xxix. Par. 4 of page 6, and par. 1 of page 7, perhaps only require a few words of explanation. In a charged Leyden jar, I have considered the two opposite forces in the inductric and inducteous surfaces, as being directed towards each other through the glass of the jar, provided the jar have no projection of its inner coating and is uninsulated on the outside, (1682.) When discharged by a wire, or discharger, or any other of the many arrangements used for that purpose, is made, these supply the "some other directions" spoken of, (1682, 1683.)

xxx. The inquiry in par. 2 of page 7, I should answer, by saying, that the process is the same as that by which the polarity of the sphere B, (iv, v,) would be neutralized, if the spheres A and C were made to communicate by a metallic wire; or that by which the 100 or 1000 intermediate spheres (x), or the myriads of polarized conducting particles (xi), would be discharged, if the inner sphere A and the outer one C were brought into communication by an insulated wire; a circumstance which would not in the least affect the condition of the power on the exterior of the globe C.

xxxi. The obscurity in my papers which has led to your remarks in par. 1, page 8, arises, as it appears to me, (after my own imperfect expression,) from the uncertain or double meaning of the word *discharge.* You say, "if discharge involves a return to the same state in vitreous particles, the same must be true in those of the metallic wire; wherefore then are these dissipated when the discharge is sufficiently powerful?" A jar is said to be discharged when its charged state is reduced by any means, and it is found in its first indifferent condition; the word is then used simply to express the state of the apparatus, and so I have used it in the expressions criticised in par. 4 of page 6 already referred to. The *process* of discharge, or the mode by which the jar is brought into the discharged state, may be subdivided as of various kinds; and I have spoken of conductive (1320), electrolytic (1343), disruptive (1359), and convective (1562) discharge; any one of which may cause the discharge of the jar, or the discharge of the inductive arrangements described in this letter (xxx); the action of the particles in any one of these cases being entirely different from the mere return action of the polarized particles of the glass of the jar, or the polarized globe B (v) to their first state. My view of the relation of insulators and conductors, as bodies of one class, is given at 1320, 1675, &c. of the researches; but I do not think the particles of the good conductors acquire an intensity of polarization any thing like that of the particles of bad conductors, on the contrary I conceive that the contiguous polarized particles (1670) of good conductors discharge to each other when their polarity is at a very low degree of intensity, (1326, 1338, 1675.) The question of, why are the metallic particles dissipated when the charge is *sufficiently* powerful—is one that my theory is not called upon at present to answer; since it will be acknowledged by all that the dissipation is not necessary to discharge; that different effects ensue upon the subjection of bodies to different degrees of the same power is common enough in experimental philosophy: thus one degree of heat will merely make water hot whilst a higher will *dissipate* it as steam and a lower will convert it into ice.

xxxii. The next most important point, as it appears to me, is that contained in the third and fourth paragraphs of page 5. I have said, (1330,) "what, then, is to separate the principle of these two extremes, perfect conduction and perfect insulation, from each other; since the moment we leave in the smallest degree perfection at either extremity we involve the element of perfection at the opposite end?" and upon this you say, might not this query be made with as much reason in the case of motion and rest?—and, in any case of the intermixture of opposite qualities may it not be said, the moment we leave the element of perfection at one end, we involve the element of perfection at the opposite? may it not be said of light and darkness, or of opaqueness and translucency? and so forth.

xxxiii. I admit that these questions are very properly put, not that I go to the full extent of them all, as for instance that of motion and rest, but I do not perceive their bearing upon the question of whether conduction and insulation are different properties dependent upon two different modes of action of the particles of the substances, respectively possessing these actions; or whether they are only differences in *degree* of one and the same mode of action? In this question, however, lies the whole gist of the matter. To explain my views, I will put a case or two. In former times a principle or force of levity was admitted as well as of gravity, and certain variations in the weights of bodies were supposed to be caused by different combinations of substances possessing these two principles. In later times the levity principle has been discarded; and though we still have imponderable substances, yet the phenomena concerning weight have been accounted for by one force or principle only, that of gravity; the difference in the gravitation of different bodies being considered due to differences in *degree* of this *one force* resident in them all. Now no one can for a moment suppose that it is the same thing, philosophically, to assume either the two forces or the one force, for the explanation of the phenomena in question.

xxxiv. Again;—at one time there was a distinction taken between the principle of heat and that of cold: at present that theory is done away with and the phenomena of heat and cold are referred to the same class (as I refer those of insulation and conduction to one class) and to the influence of different degrees of the same power. But no one can say that the two theories, namely, that including but one positive principle and that including two, are alike.

xxxv. Again, there is the theory of one electric fluid and also that of two. One explains by the difference in degree or quantity of one fluid what the other attributes to the variation in the quantity and relation of two fluids. Both cannot be true; that they have nearly equal hold of our assent is only a proof of our ignorance; and it is certain, whichever is the false theory is at present holding the minds of its supporters in bondage and is greatly retarding the progress of science.

xxxvi. I think it therefore important, if we can, to ascertain whether insulation and conduction are cases of the same class; just as it is important to know that hot and cold are phenomena of the same kind: as it is of consequence to shew that smoke ascends and a stone descends in obedience to one property of matter, so I think it is of consequence to shew that one body insulates and another conducts only in consequence of a difference in degree of one common property which they both possess, and that in both cases the effects are consistent with my theory of induction.

xxxvii. I now come to what may be considered as queries in your letter, which I ought to answer. The second paragraph page 3 is one. As I concede that particles on opposite sides of a vacuum may perhaps act on each other, you ask "wherefore is the received theory of the mode in which the excited surface of a Leyden jar induces in the opposite surface a contrary state, objectionable?" My reasons for thinking the excited surface does not directly induce upon the opposite surface, &c. is first, my belief that the glass consists of particles, conductors in themselves but insulated as respects each other (xvii); and next that in the arrangement given iv, ix or x, A does not induce directly on C but through the intermediate masses or particles of conducting matter.

xxxviii. In the next paragraph the question is rather implied than asked, what do I mean by polarity? I had hoped that the paragraphs 1669, 1670, 1671, 1672, 1679, 1686, 1687, 1688, 1699, 1700, 1701, 1702, 1703, 1704, in the researches would have been sufficient to convey my meaning, and I am inclined to think you had not perhaps seen them when your letter was written. They, and the observations already made (v, xxvi), with the case given (iv, v), will I think be sufficient as my answer. The sense of the word *polarity* is so diverse when applied to light, to a crystal, to a magnet, to the voltaic battery, and so different in all these cases to that of the word when applied to the state of a conductor under induction (v), that I thought it safer to use the phrase "species of polarity" than any other which, being more expressive, would pledge me farther than I wished to go.

xxxix. The next or fourth par. of page 3, involves a mistake of my views. I do not consider bodies which are charged by friction or otherwise as polarized, or as having their particles polarized (iii, iv, xxvii). This paragraph and the next do not require therefore any further remark, especially after what I have said of polarity above, (xxxviii.)

xl. And now, my dear sir, I think I ought to draw my reply to an end. The paragraphs which remain unanswered, refer, I think, only to differences of opinion, or else not even to differences, but opinions regarding which I have not ventured to judge.

These opinions I esteem as of the utmost importance; but that is a reason which makes me the rather desirous to decline entering upon their consideration; inasmuch as upon many of their connected points I have formed no decided notion, but am constrained by ignorance and the contrast of facts, to hold my judgment as yet in suspense. It is indeed to me an annoying matter to find how many subjects there are in electrical science, on which if I were asked for an opinion, I should have to say I cannot tell—I do not know; but, on the other hand, it is encouraging to think that these are they which if pursued industriously, experimentally, and thoughtfully, will lead to new discoveries. Such a subject, for instance, occurs in the currents produced by dynamic induction, which you say it will be admitted do not require for their production intervening ponderable atoms. For my own part, I more than half incline to think they do require these intervening particles, i. e. when any particles intervene, (1729, 1733, 1735.) But on this question, as on many others, I have not yet made up my mind. Allow me therefore here to conclude my letter, and believe me to be, with the highest esteem and respect, my dear sir, your obliged and faithful servant,

M. Faraday.

Royal Institution, April 18, 1840.

Art. XV.—*Brief Synopsis of the Principles of* James P. Espy's *Philosophy of Storms.**

(Communicated for this Journal.)

When the air near the surface of the earth becomes more heated or more highly charged with aqueous vapor, which is only five eighths of the specific gravity of atmospheric air, its equilibrium is unstable, and up-moving columns or streams will be formed.

As these columns rise, their upper parts will come under less pressure, and the air will therefore expand; as it expands, it will grow colder about one degree and a quarter for every hundred yards of its ascent, as is demonstrated by experiments on the Nephelescope.

* Copious facts going to establish the principles contained in this Synopsis, are given in Mr. Espy's Lectures.

The ascending columns will carry up with them the aqueous vapor which they contain, and if they rise high enough, the cold produced by expansion from diminished pressure, will condense some of this vapor into cloud ; for it is known that cloud is formed in the receiver of an air-pump when the air is suddenly withdrawn.

The distance or height to which the air will have to ascend before it will become cold enough to begin to form cloud, is a variable quantity depending on the number of degrees which the dew point is below the temperature of the air; and this height may be known at any time by observing how many degrees a thin metallic tumbler of water must be cooled down below the temperature of the air, before the vapor begins to condense on the outside. The highest temperature at which it will condense, which is variable according as there is more or less vapor in the air, is called the "dew point," and the difference between the dew point and the temperature of the air in degrees is called the complement of the dew point.

It is manifest that if the air at the surface of the earth should at any time be cooled down a little below the dew point, it would form a fog by condensing a small portion of its transparent vapor into little fine particles of water, and if it should be cooled 20° below the dew point, it would condense about one half its vapor into water, and at 40° below, it would condense about three fourths of its vapor into water, &c.

This, however, will not be exactly the case from the cold produced by expansion in the up-moving columns; for the vapor itself grows thinner, and the dew point falls about one quarter of a degree for every hundred yards of ascent.

It follows, then, as the temperature of the air sinks about one degree and a quarter for every hundred yards of ascent, and the dew point sinks about a quarter of a degree, that as soon as the column rises as many hundred yards as the complement of the dew point contains degrees of Fahr. cloud will begin to form. Or in other words, the bases of all clouds forming by the cold of diminished pressure from up-moving columns of air, will be about as many hundred yards high as the dew point is below the temperature of the air at the time.

If the temperature of the ascending column should be 10° above that of the air through which it passes, and should rise to the height of 4800 feet before it begins to form cloud, the whole column would then be 100 feet of air lighter than surrounding columns; and if the column should be very narrow, its velocity of upward motion would follow the laws of spouting fluids, which would be 8 times the square root of 100 feet a second, that is 80 feet a second, and the barometer in the centre of the column at its base, would fall about the ninth of an inch.

As soon as cloud begins to form, the caloric of elasticity of the vapor or steam is given out into the air in contact with the little particles of water formed by the condensation of the vapor. This will prevent the air in its further progress upwards from cooling so fast as it did up to that point, and from experiments on the Nephelescope, it is found to cool only about one half as much above the base of the cloud as below—that is, about five eighths of a degree for one hundred yards of ascent, when the dew point is about 70°. If the dew point is higher it cools a little less, and if the dew point is lower, it cools a little more than five eighths of a degree in ascending one hundred yards.

Now it has been ascertained by aëronauts and travellers on mountains, that the atmosphere itself is about one degree colder for every hundred yards in height above the surface of the sea; therefore, as the air in the cloud, above its base, is only five eighths of a degree colder for every hundred yards in height, it follows, that when the cloud is of great perpendicular height above its base, its top must be much warmer than the atmosphere at that height, and consequently much lighter.

Indeed the specific gravity of a cloud of any height compared to that of the surrounding air at the same elevation, may be calculated when the dew point is given. For its temperature is known by experiments with the Nephelescope, and the quantity of vapor condensed by the cold of diminished pressure at every point in its upward motion, and of course the quantity of caloric of elasticity given out by this condensation is known, and also the effect this caloric has in expanding the air receiving it, beyond the volume it would have, if no caloric of elasticity was evolved in the condensation of the vapor.

For example, according to the experiments of Prof. Walter R. Johnson, of Philadelphia, a pound of steam at the temperature of 212° contains 1030° of caloric of elasticity, and as the sum of the latent and sensible caloric of steam is the same at all temperatures, it follows that a pound of steam being condensed into 1198 pounds of water at 32° would heat it up 1°. And as the specific caloric of air is only 0.267, if a pound of vapor should be condensed into 1198 pounds of air, it would heat that air nearly 4°, or which is the same thing, it would heat 119 pounds of air 4°, or 100 pounds 48°, and in all these cases it would expand the air about 8000 times the bulk of water generated; that is, 8000 cubic feet for every cubic foot of water formed out of the condensed vapor. And as it requires between 1300 and 1400 cubic feet of vapor, at the ordinary temperature of the atmosphere, to make one cubic foot of water—if this quantity be subtracted from 8000, it will leave upwards of 6600 cubic feet of actual expansion of the air in the cloud for every cubic foot of water generated there by condensed vapor.

This great expansion of the air in the forming cloud will cause the air to spread outwards in all directions above, causing the barometer to rise on the outside of the cloud above the mean, and to fall below the mean under the middle of the cloud as much as it is known to do in the midst of great storms.

For example, if the dew point should be very high, say 78°, then the quantity of vapor in the air would be about one fiftieth of its whole weight, and if the up-moving column should rise high enough to condense one half its vapor into cloud, it would heat the air containing it 45°, and the air so heated would be $\frac{45}{480}$ths larger than it would be if it was not so heated. And if we assume a case within the bounds of nature, and suppose the cloud and the column under the cloud to occupy three fourths of the whole weight of the atmosphere, or in other words, if we suppose the top of the cloud to reach a height where the barometer would stand at 7½ inches, and the mean temperature of the whole column 40° warmer than the surrounding air, then would the barometer fall under the cloud at the surface of the earth $\frac{40}{480}$ths of 22.5, or a little more than two inches.

Though the air may be driven up by the ascending column much higher than the point assumed in the last article, the cloud will cease to form at greater heights, because the dew point at these great elevations, falls by a further ascent as rapidly as the temperature—and at greater elevations, it will even fall more rapidly. If for instance the air should rise from where the barometer stands at six inches to where it stands at three inches, the dew point would fall about 20°, but the temperature would fall less than 20°, and therefore no vapor would be condensed by such ascent.

When a cloud begins to form from an ascending column of air, it will be seen to swell out at the top while its base continues on the same level, for the air has to rise to the same height before it becomes cold enough by diminished pressure to begin to condense its vapor into water ; this will cause the base to be flat, even after the cloud has acquired great perpendicular height, and assumed the form of a sugar loaf. Other clouds also for many miles around, formed by other ascending columns, will assume similar appearances, and will moreover have their bases all on the same or nearly the same horizontal level; and the height of these bases from the surface of the earth will be the greatest about three o'clock, when the dew point and temperature of the air is the greatest distance apart.

The outspreading of the air in the upper parts of an ascending column will form an annulus all round the cloud, under which the barometer will stand above the mean ; of course the air will descend in the annulus, and increase the velocity of the wind at the surface of the earth towards the centre of the ascending column, while all round on the outside of the annulus there will be a gentle wind outwards. Any general currents of air which may exist at the time, will of course modify these motions from the oblique forces they would occasion.

The up-moving current of air must of course be entirely supplied by the air within the annulus, and that which descends in the annulus itself.

The rapid disturbance of equilibrium, which is produced by *one* ascending column, will tend to form *others* in its neighborhood ; for the air being pressed outwards from the annulus, or at least retarded on the windward side, will form other ascending columns, and these will form other annuli, and so the process will be continued.

These ascending columns will have a tendency to approach, and finally unite ; for the air between them must descend, and in descending the temperature of the whole column will increase, for it is known that the air, at great elevation, contains more caloric to the pound than the air near the surface of the earth, because it is the upper regions that receive the caloric of elasticity given out in the condensation of vapor into clouds. Therefore, when the air has descended some time in the middle, between two ascending columns, the barometer will fall a little, or at least not stand so high above the mean as it does on the outside of the two clouds, and so the columns will be pressed towards each other.

If one of two neighboring columns should be greatly higher than the other, its annulus may overlap the smaller one, and of course the current under the smaller cloud will be inverted, and the cloud which may have been formed over the column thus forced to descend, will soon disappear; for as it is forced downwards by the overlapping annulus of the more lofty column, it will come under greater pressure, and its temperature will be thus increased, and it is manifest that as soon as its top descends as low as its base, it will have entirely disappeared, and in the mean time the larger cloud will have greatly increased.

As the air above the cloud formed by an ascending column is forced upwards, if it contains much aqueous vapor, a thin film of cloud will be formed in it by the cold of diminished pressure, entirely distinct from the great dense cumulus below; but as the cumulus rises faster than the air above it (for some of the air will roll off) the thin film and the top of the cumulus will come in contact; and sometimes a second film or cap may be formed in the same way, and perhaps a third and fourth. When these caps form, there will probably be rain, as their formation indicates a high degree of saturation in the upper air.

When the complement of the dew point is very great, (20° and more,) clouds can scarcely form; for up-moving columns will generally either come to an equilibrium with surrounding air, or be dispersed before they rise twenty hundred yards, which they must do in this case, before they form clouds. Sometimes, however, masses of air will rise high enough to form clouds, but they are generally detached from any up-moving column underneath, and of course cannot then form cumuli with flat bases; such clouds will be seen to dissolve as soon as they form, and even while forming they will generally appear ragged, thin and irregular.

Moreover, if the ground should be colder during the day, than the air in contact with it, as it sometimes happens after a very cold spell of weather, then ascending columns cannot exist, and of course no cumuli can be formed on that day, even though the air may be saturated with vapor to such a degree as to condense a portion of it on cold bodies at the surface of the earth.

Neither can clouds form of any very great size, when there are cross currents of air sufficiently strong to break in two an ascending current, for the ascensional power of the up-moving current will thus be weakened and destroyed. This is one means contrived by nature to prevent up-moving columns from increasing until rain would follow. Without some such contrivance it is probable that every up-moving column which should begin to form cloud when the dew point is favorable, would produce rain, for as soon as cloud forms, the up-moving power is rapidly increased by the evolution of the caloric of elasticity.

If it should be found by observation that an upper current of air is passing from the mountains of Abyssinia over Egypt to the north, while the wind below is blowing from the north towards the mountains of Abyssinia, this would manifestly be *one* reason why it seldom rains in Egypt during the prevalence of this wind, though it comes highly charged with vapor from the Mediterranean. Besides, it is known that during the prevalence of this wind there are great rains in Abyssinia, and of course if the upper current does flow over Egypt from the south, it would bring in it a large portion of the caloric of elasticity, which it received there, in the great condensation of the vapor as it rose up the sides of the mountains at the head of the Nile; of course the columns of air rising over Egypt, when they entered that current would cease to rise, for the temperature of that current would be many degrees hotter than themselves, and therefore they could not swim in it.

Also, on the leeward side of very lofty mountains, there cannot be rain: for as the air on the windward side rises up the sides of the mountain, it will condense all the vapor which can be condensed by the cold of diminished pressure, before it reaches to the top, and even if a cloud passes over the top to the other side, it would soon disappear, because in passing down the slope it will come under greater pressure, and thus be dissolved by the heat produced. These are some of the causes which prevent rains at particular times and in particular localities.

If, however, the air is very hot below with a high dew point, and no cross currents of air above to a great height, then, when an up-moving current is once formed, it will go on and increase in violence, as it acquires perpendicular elevation, especially after the cloud begins to form. At first the base of the cloud will be flat; but after the cloud becomes of great perpendicular diameter, and the barometer begins to fall considerably, as it will do from the specific levity of the air in the cloud, then the air will not have to rise so far as it did at the moment when the cloud began to form, before it reaches high enough to form cloud from the cold of diminished pressure.

The cloud will now be convex below, and its upper parts will be seen spreading outward in all directions, especially on that side towards which the upper current is moving, assuming something of the shape of a mushroom. In the mean time the action of the inmoving current below and upmoving current in the middle will become very violent, and if the barometer falls two inches under the centre of the cloud, the air will cool about 10°, and the base of the cloud will reach the earth if the dew point was only 8° below the temperature of the air at the time the cloud began to form. The shape of the lower part of the cloud will now be that of an inverted cone with its apex on the ground, and it will be what is called a tornado if it is on land, and a water-spout if at sea.

On visiting the path of a tornado, the trees on the extreme borders will all be found prostrated with their tops inwards, either inwards and backwards, or inwards and forwards, or exactly transverse to the path. The trees in the centre of the path will be thrown either backwards or forwards parallel to the path; and invariably if one tree lies across another, the one which is thrown backwards is underneath. Those materials on the sides which are moved from their places and rolled along the ground, leaving a trace of their motion, will move in a curve convex behind; those which were on the right hand of the path, will make a curve from left hand to right, and those on the left hand of the path will make a curve from right hand to left, and many of these materials will be found on the opposite side of the path from that on which they stood on the approach of the tornado. Also, those bodies which are carried up will appear to whirl, unless they arise from the very centre—those that are taken up on the right of the centre will whirl in a spiral from left to right, and those on the left of the centre, will whirl in a spiral upwards from right to left.

On examining the trees which stand near the borders of the path, it will be found that many of the limbs are twisted round the trees and broken in such a manner as to remain twisted, those on the right hand side of the path from left to right, and those on the left hand side of the path from right to left. However, it will be found that only those limbs which grew on the side of the tree most distant from the path of the tornado are broken; for these alone were subject to a transverse strain.

The houses which stood near the middle of the path will be very liable to have the roof blown up, and many of the walls will be prostrated all outwards, by the explosive influence of the air within, and those houses covered with zinc or tin, from being air tight will be liable to suffer most. The floors from the cellars will also frequently be thrown up, and the corks of empty bottles exploded.

All round the tornado at a short distance, probably not more than three or four hundred yards, there will be a dead calm, on account of the annulus formed by the rapid efflux of air above, from the centre of the upmoving and expanding column. In this annulus the air will be depressed, and all round on the outside of it, at the surface of the earth, there will be a gentle wind outwards; and of course all the air which feeds the tornado, is supplied from within the annulus. Nor is this difficult to understand, when the depression of the air in the annulus is considered, for any amount may be thus supplied by a great depression.

Light bodies, such as shingles, branches of trees, and drops of rain or water formed in the cloud, which are carried up to a great height before they are permitted to fall to the earth; for though they may frequently be thrown outwards above, and then descend a considerable distance at the side, they will meet with an inblowing current below, which will force them back to the centre of the upmoving current, and so they will be carried aloft again.

The drops of rain, however, will frequently be carried high enough to freeze them, especially if they are thrown out above so far as to fall into clear air, for this air will in some cases be thirty or forty degrees colder than the air in the cloud. In this case if the upmoving column is perpendicular, the hail will be thrown out on both sides, and on examination it will be found that two veins of hail fell simultaneously, at no great distance apart.

It is indeed probable that in all violent thunder storms in which hail falls, the upmoving current is so violent as to carry drops of rain to a great height, when they freeze and become hail. It is difficult if not impossible to conceive any other way in which hail can be formed in the summer, or in the torrid zone.

In those countries in which an upper current of air prevails in a particular direction, the tornadoes and water spouts will generally move in the same direction; because the upmoving column of air in this meteor rises far into this upper current, and of course its upper part will be passed in this direction, as the great tornado cloud moves on in the direction of the upper current, the air at the surface of the earth will be pressed up into it by the superior weight of the surrounding air. It is for this reason the tornado in Pennsylvania generally moves towards the eastward.

If a tornado should stop its motion for a few seconds, as it might do, on meeting with a mountain, it would be likely to pour down an immense flood of water or ice, in a very small space; for the drops which would be carried up by the ascending current would soon accumulate to such a degree, as to force their way back, and this they could not do, without collecting into one united stream of immense length and weight, and of course on reaching the side of the mountain, this stream, whether it consisted of water or hail, would cut down into the side of the mountain a deep hole, and make a gully all the way to the bottom of the mountain from the place where it first struck.

As the air spreads out more rapidly above than it runs in below, there will be a tendency in storms to increase in diameter, and also to become oblong from the influence of the upper current in carrying the top of the cloud in its own direction.

At the equator, or at least those parts of it where the trade winds are constant from east to west, it is probable tornadoes travel from east to west. For as the air in the torrid zone is about 80° in temperature at a mean, and the air in the frigid zone is about zero, the air in the torrid zone is constantly expanded by heat about $\frac{80}{448}$ of its whole bulk in the frigid zone. This will cause the air at the equator to stand more than seven miles higher from the surface of the earth to the top of the atmosphere than at the north pole. The air therefore will roll off from the torrid zone both ways towards the poles, causing the barometer to fall in low latitudes and rise above the mean in high latitudes. This will cause the air to run in below towards the equator, and of course rise there. Now from the principle of the conservation of areas, it will fall more and more to the west as it rises, and of course the upper current of the air, at the equator probably moves towards the west.

However, as the air rolls off above, towards the north, it will be constantly passing over portions of the earth's surface, which have a less diurnal velocity than the part from which it set out, and as from the nature of inertia it still inclines to retain the diurnal velocity towards the east which it originally possessed, when it reaches the latitude of about 20° or 25°, it will then probably be moving nearly towards the north—and beyond that latitude its motion will be to the northeasterly.

If violent storm clouds, which necessarily rise to a great height into the upper current, are driven forward in the direction of the upper current, it is probable that the barometer will rise higher in that part of the annulus which is in front of the storm, than in the rear, and if so, a sudden rise of the barometer in particular localities, may become, when properly understood, one of the first symptoms of an approaching storm.

In consequence of the high barometer in front of the storm in a semi-annulus, the air will be forced downwards there, and cause in some cases a more violent action of the air or wind backwards, meeting the approaching storm, than will be experienced, in the rear of the storm.

As the air comes downwards in the semi-annulus in front of the storm, it will come under greater pressure, and therefore any clouds which it may contain, will probably be dissolved, by the heat of greater pressure, and therefore on the passage of the annulus, it will probably be fair weather.

Also, as the air above always contains more caloric to the pound, than the air below, there will be an increase of temperature on the passage of the annulus, partly from the increased pressure, but chiefly by the descent of the air; in very hot climates this increase of temperature, in front of the storm, will be very sensibly felt.

The increased pressure in the annulus round a volcano, when it suddenly bursts out, will sometimes under favorable circumstances, be very great, and of course the air will be depressed from a great height, so that some portion of the very air which has gone up in the central parts of the ascending column, and formed cloud by the cold of diminished pressure, will be forced down to the surface of the earth, bringing with it the caloric of elasticity which it received from the condensing vapor ; if so, the heat experienced at the time of this descent, will be very great.

These hot blasts of air will alternate with cold blasts, for the air which is forced down from great heights in the annulus will not only be very hot, but very dry, having condensed its vapor, in its previous ascent. Now when this hot dry air flows inwards again towards the volcano and ascends, it will not form cloud, because of its want of vapor ; and therefore the process of cloud forming will cease, and consequently rain and hail will cease too, until more air from a greater distance that has not been deprived of its vapor flows in and ascends. Then cloud will again begin to form and the violence and rapidity of the outflowing of the air above will be increased by the evolution of the caloric of elasticity, the barometer will rise rapidly in the annulus and fall in the central part of the ascending column, and these alternations may continue while the volcano is in activity, more particularly if the violence of the volcano itself should be increased periodically.

As air cannot move upwards without coming under diminished pressure, and as it must thus expand and grow colder and consequently form cloud—any cause which produces an upmoving column of air, whether that cause be natural or artificial, will produce rain, when the complement of the dew point is small, and the air calm below and above, and the upper part of the atmosphere of its ordinary temperature.

Volcanoes therefore under favorable circumstances will produce rain ; sea breezes which blow inwards every day towards the centre of islands, especially if these islands have in them high mountains, which will prevent any upper current of air from bending the upmoving current of air out of the perpendicular before it rises high enough to form cloud, such as Jamaica—will produce rain every day ; great cities where very much fuel is burnt, in countries where the complement of the dew point is small, such as Manchester and Liverpool, will frequently produce rain ; even battles, and accidental fires, if they occur under favorable circumstances, may sometimes be followed by rain. Let all these favorable circumstances be watched for in time of drought, (and they can only occur then,) and let the experiment be tried. If it should be successful, the result would be highly beneficial to mankind.

Independent of its utility to the farmer, it would be highly useful to the mariner in the following way.

As the very time and place of the commencement of the rain would be known, it would be easy to find out in what direction from the place of beginning it moved along the surface of the earth, and also its velocity of motion, and the shape that it assumed from time to time in its progress. Now this knowledge is the principal thing wanting to enable the mariner, who has the power of locomotion, to direct his vessel so, when one of these great storms comes near him, as to use as much wind in the borders of the storm as will suit the purposes of navigation—for heaven undoubted makes the wind blow for his use and not for his destruction, provided he becomes acquainted with the laws to which it is subject. From the preceding principles he will be able to know in what direction a great storm is raging when it is yet several hundred miles from him.

Art. XVI.—*A Description of a New Form of Magneto-Electric Machine, and an Account of a Carbon Battery of considerable energy;* communicated for this Journal by Oliver W. Gibbs, member of the Junior Class of Columbia College, N. Y.

It is well known, that if a soft iron bar be wound with insulated wire and caused suddenly to approach and recede from the poles of a magnet, temporary magnetism will be induced in the bar, and an electric current in the wire surrounding it. This fact led to the construction of the magneto-electric machine, the principle of which consists in alternately inducing and destroying magnetism in a bar similarly wound with large wire for sparks and deflagrations, and with small for shocks and chemical decompositions. About eight months since it occurred to me that a more simple machine than those commonly used (and which all I believe resemble that of Saxton) might be constructed. My plan was, to take a bar of soft iron of say an inch in diameter by ten inches long, and to slide upon the middle a disk of brass of two inches radius. This would divide the bar into two parts, upon one of which is to be wound three or four hundred feet of copper bell wire well insulated, and upon the other and separated from the first by the brass disk, about four times that length of fine wire, say No. 25. If now one extremity of the coarse wire be attached to one pole of the battery, and the communication between the other extremity and the other battery pole be alternately made and interrupted by means of a rasp or toothed wheel, magnetism will be induced and destroyed in the iron bar and consequently an electric current will circulate through the fine wire. The use of the brass disk is to prevent by means of a closed circuit, any immediate induction in the fine from the coarse wire, which would inevitably take place were none interposed, and which would convert the instrument from a magneto-electric to an electro-magnetic machine.

Since the above was devised, an obvious improvement has suggested itself. This is founded upon the fact that magnetism is strongest at the extremities of bodies ; and consists simply in dividing the bar into three equal spaces by means of two disks of brass similar in size to the one already described. The central division is then to be wound with the coarse and the two outer or polar divisions with the fine wire, connecting the two outer helices in such a manner that they may form one long wire. The battery current is then to be passed through the coarse wire, and the connection made and interrupted as before by a rasp or other interrupting apparatus. As thus constructed, the instrument would produce effects similar to the common magneto-electric machine when used for shocks or decomposition. If it be desired to produce sparks and deflagrations, it would only be necessary to slide off the coils of fine wire from the poles, and to substitute in their stead others made of coarse wire of shorter length and then transmit and interrupt the current through the central coil as before. We should then have within a much smaller compass, an instrument capable of producing all the effects of the common machine of Mr. Saxton, and by combining a number of such bars we might form in a comparatively small compass a magneto-electric battery of great energy. Some of Dr. Page's beautiful interrupting apparatus might doubtless be used successfully with this instrument. As I have no opportunity to construct the instrument myself, I would suggest the trial, especially of the latter form of apparatus, to any who may be interested in the subject. Should it succeed, its advantage would be its superior cheapness and power, (?) and the little space it would occupy.

About the same time that the above instrument was devised, in looking over the list of substances which are capable of forming a galvanic circle together, I was struck with the much higher electro-negativeness of charcoal than of copper in relation to zinc; there being but six substances between zinc and copper, while there are eleven between zinc and carbon, which, moreover, stands even higher than gold, and next below platina. Besides this, its excellent conducting power seemed particularly to qualify it to act as an electrometer. Accordingly, I was led to consider that it might form an excellent battery with zinc or its amalgam, and mentioned the opinion to Prof. Renwick. I was however prevented from experimentally demonstrating its powers, until in the month of March I perceived in one of the foreign journals a short account of a carbon battery which had been successfully tried in England. I immediately constructed a small battery, consisting of only six pairs of zinc and bituminous coal, and arranged as a *couronne des tasses.* The zinc plates were an inch square, consequently there were only six inches of acting zinc surface; the exciting liquid was diluted sulphuric acid. With this battery pure water was easily and rapidly decomposed, though from not having platina electrodes, and from the want of a voltameter, the gas collected was not measured. This experiment was witnessed by Mr. Schaeffer, assistant Professor of Chemistry in the College. To those who possess batteries of considerable power, I would suggest the employment of some form of carbon for electrodes in the place of platina. I hope soon to be able to present a series of experiments on the relative advantages of copper and carbon, especially in the case of the constant battery.

New York, May 9, 1840.

Art. XVII.—*Electricity in Machinery;* by Azariah Smith, Jr.

Messrs. Editors—Having frequently heard persons employed in my father's manufactory at Manlius, N. Y., speak of the development of electricity by particular parts of the machinery, I was led by an article in the American Journal for (July?) 1839, to the examination of the phenomena which furnished me with the following facts; which you will please to publish if they add any thing to the light already existing upon this subject.

Upon approaching the machinery referred to, which was connected with the spinning apparatus, and near the centre of the manufactory, I observed fibres of cotton of all lengths up to six inches, extending out in different directions from one end of the spinning frames, and waving as if about to leave their resting place for a band two and a half inches broad, which moved the machinery and connected it with a drum seven feet above; the latter being moved by another drum fifteen feet distant, with which it was connected by a horizontal strap seven inches in breadth. The two drums were of equal diameter, two feet and eight inches, but the wheel by which the spinning machinery was moved and a free pulley by its side, were only eight inches; and consequently made two hundred and eighty eight revolutions in a minute, while the former made seventy two.

Beneath the horizontal strap and four feet distant from it, the hair of the persons spinning was observed to be affected in a similar manner with the cotton, all the finer and more flexible fibres standing directly upright. Upon placing small fibres of cotton from one to two feet distant from this strap, they would ascend to it and adhering to its surface advance with it, until within a short distance of the drum around which it passed, when they would fall off and descend to the floor. Occasionally fibres would pass to and fro between the band and the hand placed near it, and once or twice this latter phenomenon took place through a space of two or three feet.

Upon slipping the narrow band from the wheel moving the machinery to the free pulley by its side, the electrical attraction of both the bands was observed to disappear, and this notwithstanding their motions were the same as before—in a moment, however, it was again manifested upon the spinning machine being set in motion by slipping the back upon the motor wheel. These latter phenomena led to an inquiry into the different circumstances of the band in the two cases, when the idea was suggested, that the wheel and the free pulley might be made of materials possessing different conducting power, but this a machinist of the manufactory informed me was not the case, both being made of iron and covered with leather. The friction of the spinning machinery, and of the motor wheel upon its axis, which were present in one, but absent in the other case, was the next difference suggested to account for the change, but as the axes of all parts of the machinery were made of iron and connected with iron frame-work, it was concluded that friction here would have no tendency to accumulate electricity. Upon watching the broad horizontal band at the moment the narrow one was slipped from the motor wheel upon the free pulley, the part of it connecting the upper part of the drums was observed to relax, while that connecting their lower surfaces, from being curved downwards by its weights became proportionally tense. In the first case, the upper part of the band was made tense by the great amount of friction in the machinery which it had to overcome, and of course, the friction of the band upon the drums was increased in the same ratio. But when the free pulley only was turned, the friction to be overcome, and consequently that of the bands, was much diminished; and this increased amount of friction of the bands upon the drums in the first case, is to be referred to as the exciting cause of the electricity.

From this statement you will observe that there was no friction of the bands upon each other as is mentioned in the article referred to above, since the horizontal bands were parallel and the vertical ones eight inches apart at their nearest approximation. In another part of the manufactory, however, two portions of a band were observed which were crossing and rubbing upon each other, but their friction was attended with no observable electrical effects. At this time however the band was passing around a free pulley; I was therefore led to inquire as to its electrical state during the motion of its machinery, and ascertained that its attractive power for cotton, &c. at such times was as great as in that of the bands already spoken of.

Although these facts do not authorize us to dispute those in Mr. —— article, yet they naturally suggest the question whether the electricity in that case was not excited by the friction of the band upon the wheels rather than upon each other, and if so, whether the apparent difference between the bands below their junction and above was not in reality caused by the application of the jar in the one case to a tense, and in the other to a relaxed portion of the band.

Not being intimately acquainted with the action of electrical apparatus in different circumstances, I am unable to say whether increased pressure of the whole flap of the common machine upon the cylinder would materially increase the amount of electricity developed, but from the above facts, as well as the nature of the case, I should suppose it would, and if so, the circumstance properly attended to in the construction of electrical machines, would render them, *cæteris paribus*, much more powerful.

Art. XVIII.—*Notice of a Report of a Geological, Mineralogical and Topographical examination of the Coal Field of Carbon creek, with an analysis of the Minerals, accompanied by Maps, Profiles and Sections;* by Walter R. Johnson, Civ. and Min. Eng. and Prof. of Chem. and Nat. Phil. in Penn. Coll., Phila.

We subjoin a notice of the valuable report of Prof. Walter R. Johnson, whose title is given above. It announces a very important deposit of coal, one among the many with which Pennsylvania abounds and which must long contribute to sustain domestic arts and industry.

In Bradford county, adjoining to the New York state line, is the northeastern extremity of the range of bituminous coal formations, which extend quite across the state from this point to Somerset county on the borders of Maryland. It also terminates the line of coal basins which, with perhaps some interruptions, reach nearly the whole length of the state, on its northern border. This coal deposit being now about to enjoy the advantage of a near connexion with the Pennsylvania public works in progress along the north branch of the Susquehannah river; its situation is of great public interest to that portion of the state of New York which adjoins Pennsylvania, near the head waters of the Susquehannah river, and indeed to the whole central portion of New York, including the salt district, from which fuel furnished by the forest is already so remote, as to become a considerable drawback upon the profits of the manufacturer. The consumption of four hundred thousand cords of wood per annum in the manufacture of salt, must indeed require a vast extent of country to be preserved in its wooded state, in order that the growth should keep pace with the consumption.

The geological character of the district traversed by Prof. Johnson, is similar to that of most other coal fields of Pennsylvania, being a secondary formation, embracing a coal trough two or three miles in breadth and of six or seven in length, its southwestern termination not being yet very accurately ascertained. The attention of Prof. J. was limited to a district embracing chiefly its northeastern portion.

"Its northern or northwestern border is along a high and tolerably uniform and continuous ridge of mountain, lying south of the valley of Towanda creek. On this creek itself, the lower beds of limestones, sandstones and shales underlying the coal measures are found at a high angle of inclination, often dipping not less than 40° or 50° towards the south or southeast. On the easterly and southeasterly parts of the coal field, on the contrary, the dip of the lower rocks is to the west or northwest, while on the southwestern parts, especially on Burnet ridge, the slope is evidently towards the north. "The coal measures lie on both sides of the Carbon creek, the valley of which, as well as those of its tributaries, is a valley of denudation, made by the action of water, which at the northeastern extremity of the coal basin has excavated its channel through the whole coal series, over two hundred feet thick, and to a depth of more than seven hundred and fifty feet below them, into the underlying strata of slates, limestones, sandstones and shales.

Great pains appears to have been bestowed by Prof. Johnson, in determining by actual survey and levelling, the true elevation of all the important points where any of the mineral deposits are opened. This was rendered necessary as well by the wilderness and uncultivated condition of the country which prevented extended observation as by the generally level position of the strata which rendered it often difficult to determine the dip in the ordinary manner.

It appears that the main beds of coal in the Bradford district are two, one of from five to seven feet and the other from thirty inches to three feet in thickness with some intermediate plies of less value. They lie about one thousand one hundred and twelve feet and one thousand two hundred and nineteen feet respectively above the level of the Susquehanna river at Towanda, distant from ten to fourteen miles. The mineral deposits constitute the upper portions, in the nature of outlying masses of the formation, and all the streams which intersect the coal field are found in so many valleys of denudation, which being wider above than below, have of necessity, destroyed more of the upper than of the lower beds of coal. This coal field, like nearly all others whether in this country or elsewhere, abounds in the argillaceous carbonate of iron and in seams of fire clay. Calcareous conglomerates are likewise seen at different elevations, but no considerable body of good limestone has yet been developed immediately within the coal field.

One circumstance worthy of remark in connection with the position of the lower coal bed in the formation, is that in the central portion of the basin, this bed reposes not on a conglomerate rock nor is it underlaid at all by such material, but rests on a fine grained gritstone five or six feet thick, distinguished from the underlying sand rocks chiefly by its superior compactness and white color. On the borders of the coal basin on the contrary, the underlying rock is a massive conglomerate of coarse pebbles many feet in thickness, capping the otherwise denuded ridges and serving by its great durability to defend the softer rocks below from the action of water and the disintegrating power of growing and decaying vegetables.

The materials collected from the several parts of the Bradford coal field have been submitted to assay by Prof. Johnson, and yielded the following results.

"*Analyses of Coal.*—Eight samples of the coal of this region have been examined.

"No. 1. This specimen is from the fifth ply of coal in the lower bed, opened near the head of Fall creek. Thickness of the ply, 5½ inches. Its specific gravity is 1.5155.

At a temp. of 300°, it loses of moisture, - -	1.3	per cent.
By distillation at a red heat of water, - -	4.5	"
Uncondensable gaseous matter, - - -	9.2	"
It contains of carbon, - - - -	62.6	"
And of earthy matter, - - - -	22.4	"
	100.0	

"The ashes are almost perfectly white, and of moderate density. This as well as the two following specimens, is from parts of the bed so near the outcrop as to yield, as in all similar cases, a higher proportion of earthy matter than would be found to exist in the coal when not exposed to any of the decomposing influences of the atmosphere.

"No. 2. This specimen was from the third ply of coal in the same opening as the preceding. The thickness of this ply is 9½ inches. Its specific gravity is 1.4485.

At 260° it loses of moisture, - - -	1.9	per cent.
And at a bright red heat it gives of water, -	6.2	"
" " " of gas, - -	9.3	"
	17.4	
It contains of carbon, - - - -	70.0	"
And of earthy matter, - - - -	12.6	"
	100.0	

"The ashes are dense, and of a grayish white color.

"No. 3. This sample is from the second ply of the same bed, the thickness of which is two inches. Its specific gravity is 1.4651.

At 220° it loses of moisture, - - -	1.2	per cent.
At redness it is decomposed, giving of water, -	5.7	"
" " " of gas, -	12.2	"
It contains of carbon, - - - -	63.9	"
And of earthy matter, - - - -	17.	"
	100.0	

"The ashes are light, and have a white color, very slightly inclining to buff.

"No. 4. This sample of coal was taken from the old drift of Miller's opening, north-west of the head of Fall creek, and from the middle coal of that bed, which is 19½ inches thick. Its structure is somewhat irregular, inclining to rhombic, and its color rusty brown. The surfaces of deposition present distinct traces of vegetable fibres in the state of charcoal. Its specific gravity is 1.3771.

It loses in moisture at 220°, - - -	2.5	per cent.
At a red heat it parts with water, - -	3.0	"
And of combustible and other gases, - -	15.0	"
It contains of earthy materials, - -	11.4	"
And of carbon, - - - -	68.1	"
	100.0	

"The ashes of this coal are almost perfectly white, or but very slightly inclining to buff.

"No. 5. This specimen is from the lower part of the upper 32 inch ply of coal in Miller's old drift, and possesses a cubical structure, with a specific gravity of 1.3784.

It possesses of hygrometric moisture, - -	1.0	per cent.
Water given out in coking, - -	3.5	"
Gas volatilized by bright red heat, - -	14.7	"
Carbon, - - - - -	65.5	"
Earthy impurity, - - - -	15.3	"
	100.0	

"The ashes are moderately light, and of a gray color, compounded of white and chocolate.

"No. 6. This sample was likewise from the upper, or 32 inch ply of coal in the old drift before mentioned. It possessed the cubical structure, and fine deep black color. Specific gravity 1.3492.

It contains of moisture, vaporized at 212°, -	1.3 per cent.
Of water, tar, &c. disengaged in coking, -	6.5 "
Uncondensable gas, - - - -	11.5 "
Carbon, - - - - -	74.97 "
Earthy matter, - - - -	5.73 "
	100.0

" The ashes are of a rather deep chocolate brown, scarcely less marked in this particular than any of the red ashes of anthracite.

" No. 7. This coal was obtained from the middle part of the bed, at Mason's mine, on the head waters of Wagner's run. The coal from this mine, is already in the highest repute, both for domestic consumption, and for purposes of the arts. It has a specific gravity of 1.388.

It is composed of the following ingredients.

Matter volatile at 390°, - - -	0.6 per cent.
Vapors condensable, - - -	2.8 "
Uncondensable gaseous matter, - -	15.4 "
Carbon, - - - - -	68.1 "
Earthy matter, - - - -	13.1 "
	100.0

" The ashes of this coal are white, slightly inclining to buff, moderately bulky.

" No. 8. This coal is from the lower part of Mason's bed; it possesses a columnar structure, the surfaces of deposition being distinctly marked, its color is deep black, surface of vertical fractures and lining.

Its specific gravity is 1.400. It contains of

Water lost at 340°, - - - -	2.1 per cent.
Volatile matter expelled in coking, - -	16.8 "
Carbon, - - - - -	68.57 "
Earthy matter, - - - -	12.53 "
	100.00

" The ashes of this coal are of a white color, rather inclining to gray, and not remarkably heavy.

" Experiments to detect the presence of sulphur succeeded in giving faint traces of that ingredient.

" From all the analyses of coal detailed in this Report, we have the following table of general results.

No.	Carbon.	Volatile matter.	Earthy matter.
1	62.6	15.0	22.4
2	70.0	17.4	12.6
3	63.9	19.1	17.0
4	68.1	20.5	11.4
5	65.5	19.2	15.3
6	74.97	19.3	5.73
7	69.0	17.9	13.1
8	68.57	18.9	12.53
Mean,	67.83	18.41	13.76

"Thus it appears that the quantity of volatile matter in this coal, is small compared with that of most other bituminous coals of our country. Being situated on the eastern extremity of the first principal range of bituminous coal formations west of the Susquehanna river, it adds another to the many evidences which have been derived from my own experiments in proof of the proposition long since advanced, that the quantity of volatile matter in the coals of Pennsylvania, and other states, gradually increases as we advance from the Atlantic region across and beyond the Alleghany mountain, over the great coal fields of the western and northwestern states.

"This law becomes the more striking when the anthracite fields are embraced with the bituminous, for there we have a series commencing almost at zero, and proceeding upwards in the scale of volatility, till, in some of the coals of Kentucky, Illinois, &c., it attains a maximum of 48 or 50 per cent. The circumstance of possessing but a moderate share of bituminousness, is favorable to the application of the coals of this region, to the purposes of iron manufacture, and though the per centage of earthy matter is higher than that of some other coals, yet it will be recollected that nearly all the samples are taken from points near the outcrop of the respective beds, and that consequently the relative proportion of earthy matter is likely to be higher than would result from the coals taken a few hundred feet from the edge of the same beds.

"*Iron Ores.*—The argillaceous carbonate of iron is the principal variety to be expected in all coal districts. The Carbon creek formation is found in this respect to sustain the general character of all our Pennsylvania coal fields, yielding ores in considerable variety, and of different degrees of richness, capable of producing from six or eight, to forty or fifty per cent. of metallic iron. These ores have been found either in place in the solid strata, or scattered in rolled pebbly masses, over so great an extent as to leave no doubt of their constituting, originally, regular portions of the formation. Thus I have collected samples from the heads of Fall creek, and from those of Long valley, as well as along the *channel* of the latter tributary; they are also met with in Wagner's Lick creek, and especially on the heads of the latter stream, where the ore has been fully exposed a few hundred yards from Mason's coal mines. Kidney ore is found in several places directly overlying the upper bed of coal.

"The lowest stratum of ore which I have been enabled to examine, is situated 1016 feet above the level of the Susquehanna. It constitutes a bed $37\frac{1}{2}$ inches thick, reposing on a bed of fire-clay, 16 inches thick, and covered with a ferruginous shale, 6 inches thick. From this statement, it will appear that the mining of this ore will be effected without any unusual difficulty.

"In the solid part of the stratum, where the influences of the weather have not interfered with its natural state, it is of a light blue color, of irregular texture, being sometimes uniform, and at others, conglomerated of clay, and fragmentary masses of iron ore with a calcareous cement. The weathered specimens are commonly of a dark brown color approaching to black, and are obviously changed from the character of carbonates of the protoxide, to hydrated peroxides of the metal. As in passing through this change some portions of earthy matter are commonly separated and washed away, the ore in this latter condition is richer than in its previous state of a carbonate, the *loss* in carbonic acid and earthy matter being greater than the *gain* in oxygen and water. This remark will also apply to the other carbonates, as compared with the hydrated parts of the balls or blocks of ore. In the process of decomposition the hydrate is often accumulated in the form of a shell, more or less regular upon the exterior of a nucleus of spongy earthy matter, nearly destitute of iron; such shells are occasionally found in the bed now under consideration. The following are the results of my examination of this ore.

"No. 1. A specimen of this ore from near the outcrop was selected, having the elongated kidney form, a shell enclosing white earthy matter, its color in recent fractures of the shell, dark brown.

"Its specific gravity was 3.2264 at a temperature of 56° Fah. It lost at 320°, $2\frac{1}{2}$ per cent. in water; and by the application of a white heat for some time, the combined water expelled, amounted to 21.1 per cent.

"An assay of this ore in the dry way, without any admixture whatever, gave of metallic iron, 32.5 per cent., and of earthy cinder, 29.8 per cent.; oxygen, 14.1 per cent.; water, 23.6 per cent.; of which 2.5 per cent., as above stated, was uncombined.

"The pig metal obtained in this assay was of a light gray color, and rather brittle. This trial proves that the ore will not actually require the use of any flux for its reduction.

"No. 2. This sample was taken from under the fall, below the lower bed of coal and was in the original state of the mineral not changed to hydrate, as in the preceding example. Its color is light blue, its texture amorphous, or foliated, its fracture irregular; some shining particles, probably pyritous, are distributed through it.

"Its specific gravity is 3.0549. At 320° it loses 0.5 per cent. It loses when heated to whiteness, 10.5 per cent. of carbonic acid, with probably a little sulphur. The amount of iron contained in this ore, was 24.2 per. cent.; of earthy materials, 49.2. The state in which the iron exists in this ore is doubtless that of a proto-carbonate. The cinder was brittle, of a green color, and perfectly fused.

"No. 3. This ore was taken from the fifth ply of a bed about 10 feet in thickness, and at an elevation of 1080 feet above the Susquehanna, and 64 feet above the $37\frac{1}{2}$ inch bed already described. The ply is 18 inches thick.

"This ore has a brown or ochrey appearance, and being taken from a point at no great distance from the outcrop, has evidently undergone a change from atmospheric influences. Its fracture is uneven, and its texture analogous to some of the argillaceous shales. Its specific gravity is 2.7256. It contains of hygrometric moisture, vaporizable at 320° Fah. 2 per cent.; of water in combination, 4.8 per cent.; metallic iron, 44 per cent.; earthy matter, 24.3.

"The remaining four portions of the 10 feet bed, from which the preceding sample was taken, were examined, and found to yield different quantities of iron, from 6 to 16 or 20 per cent. It is probable that in working some of the other varieties of ore, portions of this 10 feet bed will be found available as furnishing materials to promote the fusion and facilitate the working of the richer descriptions, which do not contain a sufficient quantity of earthy ingredients to produce a good cinder for the protection of the iron in the hearth.

"No. 4. This sample is from a stratum of iron ore and fire clay found on Fall creek, at an elevation of about 46¾ feet above the lower bed of coal, or 1158 feet above the river. The bed of materials in which it occurs, is 2 feet 6 inches thick, of which four inches at the bottom are fire clay, the remaining portion iron shale, intermixed with flattened reniform masses of argillaceous carbonate of iron, and some carbonaceous matter derived from fossil vegetable remains. The whole bed, together with the superincumbent mass of coarse sandstone rock, or fine conglomerate, appears to have fallen from place, and the situation was not therefore favorable for determining the real value of the bed. The sample submitted to experiment, was a fair type of the ore in this bed; but it should be added, that all which we could conveniently obtain at this place, had undergone a change, and been reduced from carbonate to hydrate. Its specific gravity was found to be 3.2113.

It lost of hygrometric moisture, - - -	3.5	per cent.
Of combined water expelled by a full red heat, -	12.7	"
Pig metal, - - - - -	53.4	"
Earthy matter, - - - - -	5.8	"
Oxygen, - - - - -	24.6	"
	100.0	

"The pig metal is of good quality, soft, gray, and tough. The cinder was imperfectly fused, but with 20 per cent. of lime, would probably be fully reduced.

"No. 5. This ore was discovered on the head waters of Long Valley creek, in a decayed and broken down portion of the measures, in such a situation as induces me to believe that its original place in the formation is near the level of the lower bed of coal, probably a little above it. Its color is brown, externally, and yellowish within; it is evidently a hydrate, formed by the decomposition of carbonate. Its specific gravity is 3.3604.

It lost of water, by heating to 320°,	- -	3.8 per cent.
And at a white heat,	- - - -	14.1 "
Of pig iron, it gave	- - - -	48.4 "
Earthy matter,	- - - - -	3.9 "

"The pig metal was gray, tough, and moderately soft; the cinder opaque, grayish white. In this assay, the cinder was rather imperfectly reduced, and some portions were probably lost.

"No. 6. This specimen of ore was taken from a pit sunk about 8 feet deep, near Mason's coal mines, on the head waters of Wagner's run: the band of flattened balls, very closely compacted together, is six inches. This band of ore is found near the northeasterly outcrop of the series of coal measures, a few feet only above the level of the heavy stratum of conglomerate rock, which marks so distinctly the limit of the basin in that direction. In this same locality, are exposed three other strata of ore, the first of which is $5\frac{1}{2}$ feet above the one now under consideration, the second $6\frac{2}{3}$ feet, and the third about $7\frac{1}{2}$ feet. This last is a band of balls, as will be more particularly stated below; hence, it will be seen, that all four of these bands of ore may be worked together, within a vertical height of 8 feet. The total thickness of the four bands being about 18 or 19 inches, and the intervening matter to be mined out, ferruginous slate, and rather friable sandstone, will not, I apprehend, present any serious difficulties in the mining.

"The following section shows the whole of these measures, commencing at the top.

1. *Balls of iron ore,*	- - - -	0 feet	3 inches.
2. Slaty sandstone,	- - - -	0 "	9 "
3. Upper *band* of *iron ore,*	- - -	0 "	6 "
4. Siliceous iron shale,	- - -	1 "	0 "
5. Middle band of *kidney ore,*	- -	0 "	5 "
6. Ferruginous slate,	- - - -	5 "	0 "
7. Lower band of compact *balls of iron ore,*	-	0 "	6 "
8. Iron shale,	- - - -	1 "	6 "
9. Black slate,	- - - -	0 "	6 "
10. Iron shale,	- - - -	1 "	8 "

"The four varieties of ore found at the above locality, are also met with in various other situations, especially on Long Valley creek, in the bed of which, samples exactly similar to the lower band of the above section, have been observed in numerous places. This band is of a durable texture, and appears to resist more firmly than the accompanying materials, the decomposing action of the atmosphere, and hence it continues unaltered in places where all the others have been washed away. The specific gravity of this lower band is 3.265.

It loses by calcination, - - - -	22.7	per cent.
And gives of iron, - - - -	29.4	"
Earthy matter, - - - - -	36.7	"
Volatile matter, oxygen, &c., - - -	11.2	"
	100.0	

"No. 7. This is the middle ply of the ore in the bed near Mason's coal mines. It is found in a stratum of kidney-shaped balls, five inches thick. Its color, in fresh fractures, is dark bluish gray, surface splintery, occasionally giving conchoidal fractures, compact, and of uniform texture. Its specific gravity is 3.763.

Heated to 320°, it loses but - - -	0.2	per cent.
Fully calcined, it loses in addition, - -	29.8	"
Treated with pure lime, it yields at once malleable iron with a little oxide, - - -	45.	"
Earthy impurity, - - - -	4.1	"
Oxygen, - - - - -	10.9	"

"This stratum affords the richest ore which has fallen under my notice from any coal formation, for the sample above analyzed was not a surface specimen reduced to the state of a hydrate, but a well marked solid carbonate, with only a thin surface coating of hydrate. It will probably be found expedient to work it with either No. 1 or No. 3, or with both together, in order to obtain a good soft pig metal.

"No. 8. This ore is found in the upper of the three bands already mentioned. It generally presents the appearance of nearly square blocks, or brick-shaped masses, seven inches thick. Above this ply of ore, is a course of balls separated from it only by a few inches of friable sandstone. A coarse quartzose grit lies a little higher. The aspect of this ore, when it has not undergone any decomposition by atmospheric influences, is a dark gray color, a rather rough surface, and a mixture of shining metallic particles interspersed through the body of the ore, as well as on its surface. Its specific gravity is 3.4783.

At 320°, it loses, - - - -	0.4	per cent.
At a white heat it undergoes decomposition, and loses, - - - - - -	25.8	"
It smelts without difficulty, and yields of pig iron,	43.3	"
It contains of earthy impurities, fusing into a dirty white cinder, - - - - -	25.4	"
And the oxygen is, - - - -	5.1	"
	100.0	

"The pig metal obtained was soft, gray and tough. There is no doubt in my mind, that this ore will be found to work well either by itself, or with the other ores found in this bed.

"No. 9. This specimen was from the stratum of balls three inches thick, in the above mentioned opening. Its color is yellowish or dark brown. Its specific gravity is 3.4977.

At 320°, it loses - - - - -	0.5	per cent.
Calcined to whiteness, it loses in addition, -	25.5	"
And when smelted, yields of pig metal, - -	45.6	"
Of earthy impurities, it contains, - -	10.7	"
And of oxygen, - - - - -	17.7	"
	100.0	

"The iron is moderately tough, and of a light color, appearing rather less favorable for foundry purposes than the results of the other plies in the same bed.

"No. 10. This specimen was found on Wagner's run, the precise elevation not ascertained. It appears in many respects analogous to the ore in the 37½ inch bed on Fall Creek, being a conglomerate of pebbly masses of clay ironstone, with a cement of earthy and ferruginous matter. Its specific gravity is 2.823.

It contains of water, - - - -	9.2	per cent.
It yields of pig metal, - - - -	29.8	"
It contains of earthy impurities, - -	50.	"
Oxygen, - - - - - -	11.	"
	100.0	

"No. 11. This specimen, as well as the preceding, was found in the channel of Wagner's run, but as there can be no doubt of its having belonged to a regular stratum of ore not yet explored, but of considerable thickness, it was deemed expedient to examine its properties. Its specific gravity is 3.5065.

"It yields 50 per cent. of pig metal, soft, gray and tough. It resembles strongly the ores found in the bed of Long Valley creek, in some parts in large quantities, and also has a striking similarity to the upper ply in Mason's ore pit. It contains but 8 per cent. of matter insoluble in acids.

"From the foregoing details, it will be observed that the yield of the several ores is as follows, viz.—

No. 1.	-	32.5	No. 7.	-	45.0
2.	-	24.2	8.	-	43.3
3.	-	44.0	9.	-	45.6
4.	-	53.4	10.	-	29.8
5.	-	48.4	11.	-	50.0
6.	-	29.4	Mean,		40.5 per cent.

"*Fire Clay.*—At least three strata of fire clay have been observed on the waters of Fall Creek; one 16 inches thick, under the 37½ inch bed of iron ore; one 4 feet thick, above the 10 feet bed of ore and iron shale;

and another still higher, accompanying a bed of ore under the coarse gritstone or conglomerate. This clay, of the 4 feet bed, has a dark gray color, compact structure, and possesses a specific gravity of 2.646. In the fire it becomes reddish white, but is otherwise unchanged except by cracking, as it shrinks, and displaying on the exterior some traces of oxide of iron.

" *Limestone.*—Limestone occurs in such quantities as to leave no doubt of its constituting a regular part of the formation. It was observed not only in the bed of Carbon creek, but also in that of the Long valley, Fall creek, and some other tributaries. It is of the gray fossiliferous variety and belongs in the strata below the coal. The fact of having noticed some of it not far from the great falls of Fall creek, has induced me to believe that it must be found in place within a moderate distance of the bottom of those falls.

" A sample of the limestone picked up in the channel of Long Valley creek, possesses a specific gravity of 2.7054.

" It contains about	40	per cent.	carbonate of lime.
"	3.5	"	peroxide of iron.
"	56.5	"	insoluble argillaceous matter.
	100.0		

" This limestone will probably be found sufficiently pure to serve as a flux for any of the ores above enumerated.

" As the valley of the Towanda creek, below its junction with the Carbon creek, presents many localities where fossiliferous limestone of lower strata than that above described, are brought into view, it was deemed proper to make also some trials to determine its degree of purity: its color is reddish gray. Its specific gravity is 2.658.

It yielded of	carbonate of lime, - - -	45.5	per cent.
"	peroxide of iron, - - -	5.5	"
"	earthy argillaceous matter and sand, -	49.0	"
		100.0	

Besides the geological character of this county, and an analysis of the minerals, Prof. Johnson has given some valuable statements respecting the timber, water power, and facilities for transportation afforded by a continuously descending line of railroad, of which he has traced the route and given the details of grade, direction, and expense. The amount of surveying and levelling, including that which refers to geological, as well as to topographical purposes, amounts to upwards of thirty-five miles, and when the direction of this part of the work is added to the actual exploration of a wide tract of wilderness, in which scarcely a bridle path is said to have existed before it was cut out by the exploring party, and in a region where tents and extemporaneous log cabins were the only lodgings, it will require no great effort to conceive the amount of labor which has been bestowed on the subject of this report. The only previous survey of the Bradford district, was, we believe, a partial one, made a few years since by R. C. Taylor, Esq., but we are not aware that even of this any account has been published. The State geological survey of Pennsylvania has not yet reached Bradford county, but we cannot doubt that when it arrives in this region, the investigations of Prof. Rogers will fully confirm those of Prof. Johnson.

Art. XIX.—*References to North American localities, to be applied in illustration of the equivalency of Geological Deposits on the eastern and western sides of the Atlantic; by* Amos Eaton. *Brongniart's theoretical table of succession, is adopted.*

Bakewell, in his popular and very instructive treatise on geology, manifests a preference for the views of Brongniart. American geologists who have attempted the application, find a remarkable accordance of his system with our own rocks.

I limit myself, in this article, to definite American localities, for fixing the limits between the seven classes of M. A. Brongniart, as applied to this country.

For the purpose of making myself understood by those who may not have seen the original, I insert a familiar view of the outline of his system, as first published in 1829; which, as the author has signified to me in the present year, he still adopts.

I have been highly interested and much instructed, by the striking application of the groups of De La Beche, to our rocks. But the geological deposits of England, appeared to me, (from his descriptions,) to be too limited in extent for giving laws in detail to our vastly extended deposits.*

Brongniart's seven classes of rocks and earths (Roches et Terrains). *General groups of organic remains are chiefly*

* About seventeen years since, I was severely censured in a public journal, for adopting De Luc's suggestion, that European geologists must cross the Atlantic, to find strata of sufficient extent for giving laws of generalization to their own rocks. I believe I can congratulate our scientific friends *almost with the assurance*, that we are to expect visiters of similar views, the present summer, of very high standing.

from M. Adolphe Brongniart's Ancient Vegetation of the Earth. See pp. 315 to 329, Vol. xxxiv, Am. Jour. Science.

1. PRIMITIVE CLASS. *Agalysient*, Gr. *ago*, to effect, *luo*, (*luso*,) overthrowing or breaking up by internal force.

Contains no organic remains; but a few ground pines, (*Lycopodeæ*,) grew on the surface, and are now found in the lowest rocks of the next class—particularly the argillite.

2. TRANSITION CLASS. *Hemilysient*, Gr. *hemi*, half, *luo*, breaking up by internal force.

Contains, in its lowest strata, some remains of ground pine; which, in some localities, are converted into coal (anthracite). Some chambered mollusca and some trilobites are found here, together with Crinoideæ and fungites. Vast quantities of ground pines, rushes and ferns, grew on the surface, which are now converted into the coal formation of the next class.

3. LOWER SECONDARY CLASS. *Abyssient*, Gr. *abussos*, deepest abyss of the ocean. The sediment of the unfathomable abyss of oceans; from which the waters have retired by the elevation of the sediment, or by depressions of former elevations, or into deep caverns.

Contains vast quantities of coal in some of its lowest strata, made of the ground pine, rushes and ferns, which grew on the surface of the preceding class.

4. UPPER SECONDARY CLASS. *Pelagient*, Gr. *pelagos*, the ocean. Sediment of the ocean of ordinary depth, from which the waters have retired.

Contains some remains of Coniferæ and Cycadeæ (pine, cedar, yew, sago-plant). Some of the uppermost deposits contain vertebrated animals, such as gigantic lizards.

5. TERTIARY CLASS. *Thalassient*, Gr. *thalassa*, sea. Sediment of seas, or mediterranean seas.

Contains mammiferous animals; and broad-leaved trees, as birch, poplar, elm, walnut, maple.

6. DILUVIAL CLASS. *Clysmient*, Gr. *kluzo*, to deluge or inundate. Sediment of extensive floods or deluges.

Contains mammalia resembling those now on the earth; but not the same species. Also recent vegetables and fresh-water shells; but no human remains nor works of art.

7. ALLUVIAL CLASS. *Alluvient*, Lat. *alluo*, to wash. Sediment from present washing of rivers, torrents, &c.

Contains present species of animals and vegetables; also works of art.

Limit between Primitive (Agalysient) *and Transition* (Hemilysient) *rocks.*

The well known *Stockbridge marble,* (primitive or granular limerock,) is the upper stratum of the primitive rocks of Brongniart. A splendid specimen is the great City Hall of New York.*

Beginning at West Stockbridge in Massachusetts, this range runs northerly through Williamstown, (the College stands on it,) Middlebury in Vermont, (very near the College,) and extends onwards far into Lower Canada. Southerly it runs a little west of the southwest corner of Massachusetts, west of Taughconnuck Mountain, to Barnagat on Hudson River. Crossing the Hudson, it passes southwesterly between Newburgh and Butter Hill, of the Highlands. Passing onwards in a southwesterly direction, it crosses into New Jersey, Pennsylvania, &c., unbroken, into the Southern States. I have traced it between three and four hundred miles. It varies exceedingly in its texture and constituents. It often becomes very perfect dolomite—is often friable, and frequently contains pyrites and micaceous masses. It never contains a fragment of organic remains.

The Argillaceous slate meets the granular limerock (primitive) near the meeting boundaries of Massachusetts and New York, at and near the northwest corner of Massachusetts. Near the east foot of Williamstown Mt., three or four miles west of the College, is a very abrupt meeting of primitive limerock and transition argillite. Immediately adjoining the limerock the slate has a talcose glazing, as described by Brongniart; but the organic remains in the Hoosick slate-quarry, demonstrate it to be a transition rock. Our State paleontologist, (Mr. Conrad,) has not yet given us a name for our abundant petrifaction in this rock. I must, therefore, describe it. From Hoosick slate-quarry to the quarry in Dutchess county, (a distance of sixty miles,) and from Massachusetts line to Hudson river, (about twenty miles,) we find what appears like the fruit-spike of the Lycopodium rupestre, (festoon pine,) about two and three inches in length, and one eighth of an inch in diameter. I have seen more than twenty of them in a square foot of a piece of roofing slate. At Hudson city, on the river bank, it abounds in the siliceous slate or basan-

* One and sometimes two alternations of talcose slate with this rock, precede this locality.

ite, which is imbedded in argillite. It is unquestionably a vegetable petrifaction, and exceedingly abundant throughout more than two thousand square miles of surface. This being, geologically, the lowest rock in North America, which contains organized remains, its meeting with the primitive limerock, is the meeting of the primitive and transition strata.

In tracing the localities of the meeting of these classes, we will begin at West Stockbridge, where we began with the primitive limerock; because the argillite is co-extensive with that limerock. It runs north, and forms the vast prominences called Bird's Mountains, between Rutland and Poultney in Vermont. It continues northerly, with various degrees of elevation, to a great distance into Canada. It runs southerly, on and near the east boundary of the state of New York, curving westerly along the westerly side of Taughconnuck Mountain, its western part forming the banks and bed of Hudson River. Its eastern limit is between Newburgh and the Highlands, where its meeting with the primitive limerock is very manifest. Poughkeepsie on the east side of the Hudson, and Newburgh on the west, stand on the argillite.

Limit between Transition (Hemilysient) *and Secondary, lower and upper* (Abyssient and Pelagient) *rocks.*

In article No. IV, published in Vol. XXXVI, p. 61, and note, p. 198, of this Journal, I endeavored to prove that the rock which I had named *Corniferous Limerock*,* is the best North American standard of reference for making out our equivalents to European rocks; particularly as it is Brongniart's upper transition rock.† Unless state geologists are to abandon geology as a science, and to amuse us with local names, insulated and heteromorphous in character, they must make it their chief object to find out transatlantic equivalents, since we cannot doubt, that such may be ascertained. I was delighted (after being panic-struck with some state geologists' reports) to see the report of the legislative committee of the State of New York, (dated April 28th, 1840,) in which the sentiments of the committee cannot be misunder-

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* This name I adopted many years since, as a mere temporary name, because I could not reconcile its characters to mountain limerock, either by foreign descriptions or by specimens in Gibbs's cabinet. Now I am satisfied *that this name*, or some other new name, is *essential*. See the confusion in De La Beche, Bakewell, Brongniart, &c., among the names grauwacke, lime grauwacke, mountain limerock, &c.

† I called it the upper rock of lower secondary in some publications.

stood. Our state geologists, it is to be hoped, will adopt the maxim, "*verbum sat.*"

On reviewing my notes and specimens since I wrote the article of Vol. xxxvi, p. 61, (to which I refer the reader,) I feel compelled to say, that the corniferous limerock is equivalent to some part or most of the grauwacke group of De La Beche, the grauwacke limestone of some English writers, the grauwacke slate of Bakewell, perhaps the carboniferous rock of Conybeare; and surely the upper transition (or one of the Psammite) rocks of Brongniart. It is true, that in our country, it is uniformly, almost wholly, a limerock, and always contains hornstone. But its relative position, and its numerous organic remains, are unequivocal. I have found in corniferous limerock, (and have them now before me,) seven species of Cyathophyllum, one Producta, one Belerophon, two Orthocera, one Calymene, and one Asaphus, which De La Beche quotes as being found in the equivalent rock in Europe, which he places in his grauwacke group.

If we should consider our rock as extending upwards in alternating portions, so as to compass all De La Beche's grauwacke group, we might attempt to make out the following equivalents. Beginning on the encrinal limerock at Fort Plain on the Mohawk, we find real *carboniferous grauwacke*, containing thin layers of anthracite, and three species of trilobites. On this, if we proceed southwesterly, we find the *red sandstone*, containing vast salt springs, from a little west of Utica to Queenstown in Canada, beyond Niagara River. For *fer carbonate* of Brongniart we find a vast stratum of lenticular iron ore. Our fetid stratum of geodiferous limerock containing gypsum may be the *calcaire fetide celluleux et gypse* of Brong. And our hydraulic cement, liasoid, may be at least compared with the *lias* of Europe. I do not pronounce these to be equivalents, as they may be an older exhibition of a repeated group. But if the objection to our corniferous limerock is removed, these rocks ought to be reviewed, and their organic relics carefully compared. In this case, organic remains alone must decide, on account of the vague character of European grauwacke.

Limit between Secondary (Pelagient) *and Tertiary* (Thalassient).

The limit between Brongniart's secondary and tertiary deposits is most perfectly and definitely presented along the south shore of Raritan Bay in New Jersey, from South Amboy to Neversink. Most of the towns in the counties of Monmouth and Middlesex afford equally satisfactory illustrations; but they are not so open to inspection in all places. The uppermost of the secondary deposits is the cretaceous formation, most perfectly characterized; but it contains no white chalk. The lowest of the tertiary is the plastic clay; but the overlying marly clay and marine sand, generally including bog ore, &c., are most extensive. Dr. Morton sent numerous specimens of the cretaceous deposit to Brongniart and Mantell, with its organic remains; and has also taken other means to put the question forever at rest.* Every potter-baker in New England, New York, and New Jersey, can testify to the character of the plastic clay, which rests on the green sand variety of the chalk (cretaceous) formation.

The student, or geological surveyor, is requested to take a boat from South Amboy to Middletown Point, along the south shore of the bay. Here he will find lignite and minute specks of amber, embraced in plastic clay, and marly clay, (marine marle,) precisely as described and drawn by Brongniart in his geological tables. It is in some places at the water's edge, at others high in the banks. He should then take a view of the two deposits within a circle of four or five miles, about Middletown Academy. He will be forcibly impressed with the geological history of that district. The cretaceous formation seems to have been the uppermost deposit for many ages; and to have been moulded into rounded hillocks, with some gorges cut by rivulets and some by large streams. While in this state a new disturbing force threw upon it the plastic clay, the marly clay, and marine sand. In some places these new tertiary deposits did not cover the tops of the hillocks, but left rounded elevations of this secondary deposit, higher than the more recent tertiary.

If the student carries in his mind these views of the meeting of the two classes along the southern parts of Staten Island, Martha's Vineyard, &c., he will find numerous evidences of the same formation underlaid by red marl, sandstone, &c.

I am not able to refer definitely to Brongniart's point of subdivision of his secondary formation into *upper* and *lower secondary.* It is at the meeting of the foreign *lias* and *Jura limestone.* Bakewell says that lias clay separates oolite (of Jura limestone) from the lias beneath it. As genuine oolite has been found by Dr. Horton in New Jersey, near the south line of Orange county,

* The opinion of these eminent men in support of Dr. Morton's views, has been fully expressed in this Journal.

(probably extending into it) here our state geologists ought to search for the true lias. Two miles north of Knox village in Albany county, is the genuine *coral rag*, as many foreign geologists have decided. This according to Brongniart, is immediately above the uppermost of the true Jura limerocks. If our state geologists will begin at this rock and descend to Livingston's Cave, making careful comparisons with the organic remains, I think some valuable discoveries may be made. The strata are numerous and thin. A little below the *coral rag* is a coarse sandy rock which breaks by natural cleavages into most perfect parallelopipeds. It abounds in univalve shells—probably some of the Bellerophon. Livingston's Cave is in a coarse, harsh, slaty sandrock. I have not searched for its organic relics. Being in very ill health when I visited it, I merely learned that it was entitled to particular examination.

Limit between Tertiary and Diluvial deposits (Thalassient and Clysmient).

The most perfect locality for the illustration of this limit, is along the Erie Canal from Rome to Pittsford, a distance of 130 miles. Here we see at short intervals, gorges in the tertiary clay, sand or tufa, of greater or less extent and depth. These gorges are generally filled or partly filled with diluvial deposits of vegetable matter, shells, gravel, &c. which must have been washed in, by waters elevated beyond the limit of any existing cause. Hence it must have been caused by a deluge. At low levels, diluvial deposits are known by their resemblance to those of higher elevation. Hence we know, that the city of Troy, N. Y. is chiefly built on diluvion ; because it is made up of similar materials with that of the great diluvial trough of Erie canal and of other similar deposits ; which required a deluge for their construction. We have a general diluvial deposit, which I have called a diluvial mantle, or ultimate diluvion. This is the last sediment of a general deluge. It is a yellowish gray, or grayish yellow covering of all other deposits in all ancient uncultivated forests. It is called the loam over hard-pan in New Hampshire, Vermont, western New York, &c.

Limit between Diluvial and Alluvial deposits (Clysmient and Alluvient).

These last deposits (which are all necessarily produced by water of ordinary elevation) are alluvial, unless their analogy of character demonstrates them to be *diluvial.*

Alluvion is divided into *Caillouteux*, gravel, (as below the sloop-dam in Troy.) *Limoneux*, loam and fine sand, (as at and near the Overslaugh below Albany.) *Phytogene*, peat and vegetable loam, as in all cases where vegetable matter has become pulverulent or turfy. A remarkable locality is to be seen along the bank of Erie Canal, west of Nine-Mile-Creek, for several miles. It generally overlies the tufa in that locality; but it is not necessarily a relative position.

The limit between the tertiary and diluvial, and between the diluvial and alluvial, is truly a matter of common sense. I would apologize for attempting this common sense limit, were it not excusable on the ground of uniformity.

With the exception of Brongniart's division of his secondary strata into *upper* and *lower*, I think I have referred to satisfactory American localities, for finding out the true limits of all his classes. It is true that every geologist cannot afford time for visiting the localities referred to: but geology as a science, is a book of vast geographical extent, and no index to this department of the study of nature, can be sufficient to present to the student, a view of the great book of this giant science. *State geologists are differently situated.*

With the hope that this abstract from my journals of about seventeen thousand miles of travel, (more than a moiety at the expense of the Hon. S. Van Rensselaer,) arranged according to Brongniart, may be useful to the zealous student, and juvenile state geologist, I subscribe myself the humble servant of all zealots in the science. AMOS EATON.

Rensselaer Institute, Troy, N. Y., June, 1840.

P. S.—Catskill Mountain presents a fair exhibition of the Allegany, Catskill, and Helderburgh range, at a point nearly west of the village of Catskill; taking a transverse section of about fourteen miles. The rock on the bank of the river east of the village is transition grauwacke. This passes under the calciferous sandrock, best for examination and its usual abundance of quartz crystals, two miles north of the village. Both rocks pass under corniferous limerock at two miles west of the village, on the Mountain road. The last passes under the true Psammite of Brongniart, which contains bituminous shale and a little coal resting on corniferous limerock. This is seen in the south bank of Lake Erie, at the water's edge and a little below; on Seneca Lake, Cayuga Lake, &c.

Art. XX.—*Notice of Minerals from New Holland;* by F. Alger.

Read before the Boston Society of Natural History, June 4, 1840.

For the minerals of which I propose to offer a brief notice on the present occasion, I am indebted to John Eldridge, Esq., of Yarmouth, Mass., who very liberally permitted me to select them from a collection purchased by him several years since, while on a visit to Calcutta, to which city they had recently been brought as "curiosities," by a person from the coast of New Holland. Their exact locality it is not in the power of Mr. E. to give me, a circumstance to be regretted, as the information would give additional interest to the specimens, by directing future discoverers to the spot where others of still greater interest might probably be met with. They comprise several species of the genus Kouphone-Spar, with varieties of rhombohedral and uncleavable quartz of Prof. Mohs. Their uniform gangue is amygdaloidal trap, to which they are attached in geodes, or groups of implanted crystals, or in compact nodules filling up the cavities of the rock.

This trap is exactly similar to that brought from Ireland, the Hebrides, and the Ferroe islands. There are a few masses of a more compact character among the collection, giving evidence of the contiguous occurrence of genuine basalt; thus offering a new object of interest, which we hope will induce some enterprising naturalist to explore this region, now that the facilities of communication with it have so much increased. Less is known of its mineralogical productions than of any other department of its natural history, though the public has been favored with the journals of several scientific expeditions to Australia. These works I have consulted with the view of finding the probable locality of the minerals now referred to, and I have thus obtained information which applies to a few of them. I find mention of both amygdaloid and basalt in the interior, as well as upon the sea coast; but these rocks are spoken of only as affording remarkable picturesque or geological scenery, and not in reference to their contained minerals. Among the specimens brought home by Capt. King, who made a survey of the western coast of Australia between the years 1818 and 1822, were agate, jasper, carnelian, green chalcedony, and heliotrope, bearing with them portions of the trap rock, but unaccompanied by any of the zeolites.* In describing the same class of rocks, Major Mitchell, the author of a more recent and fuller journal of observations,† has enumerated the following substances, in addition to the quartzose minerals referred to, forming large veins and masses in the trap: "decomposing feldspar," "granular feldspar," "crystals of glassy feldspar," and "laminated feldspar." As these substances are not very common in secondary or basaltic trap, I would suggest the possibility of the author's having mistaken their true character, especially as he was obliged to pass rapidly from place to place, and does not appear to have collected specimens of them for subsequent examination. To the unpractised eye, efflorescent zeolite might be readily mistaken for decomposed feldspar, and other species of zeolite or carbonate of lime, confounded with the other varieties of feldspar. We must think it possible, therefore, that if Major Mitchell had given the same attention to crystals, which he has bestowed upon plants, many interesting substances, overlooked or mistaken by him, would have been brought to light, and the mineralogical interest of his work greatly enhanced. It would appear, then, that none of the Kouphone-spars have been described by either of the writers whose observations have reached us, and I am not aware that any of a more recent date have appeared. They are, I believe, the first and only collection of minerals which has been brought to this country from New Holland, and certainly their uncommon beauty, and the perfection of their crystalline forms demand for them some public record.

Apophyllite. (Pyramidal Kouphone-spar, M.)—There are peculiarities in the secondary modifications of the crystals of this mineral, as well as in the general appearance of the specimens, which evidently indicate their having come from localities quite distinct. In one, Mésotype *épointée* of Haüy, the primary square prism is in elongated crystals, replaced on all the solid angles by triangular planes, and often so deeply as entirely to obliterate the

* See appendix to King's narrative, drawn up by Dr. Fitton. Analogous specimens are also described in the journal of M. Péron, one of the naturalists to the French expedition to New Holland, at about the same period.

† In two vols. 8vo. London, 1838. It is surprising that this work has not received in this country more notice and commendation. It is certainly a most remarkable work, full of stirring incident. The author has penetrated into the *interior* of New Holland, where he informs us he has found the craters of recent volcanoes, and immense mountains of lava.

terminal primary faces P, at both extremities of the crystals; thus tending to two four-sided pyramids having square bases, as in Fig. 1. But as the crystals are usually implanted on the matrix in a vertical position, they commonly present only one of the pyramids, the apex being entire, or showing a portion (sometimes only visible by the microscope) of the summits of the prism, as in Fig. 2. Sometimes one of the faces of the pyramids is considerably extended at the expense of the two adjoining ones.

Fig. 1.

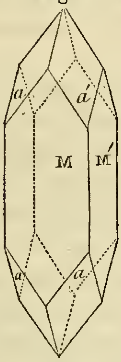


Fig. 2.

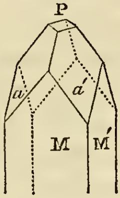


Fig. 3.

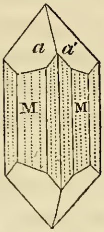
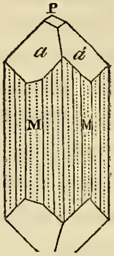


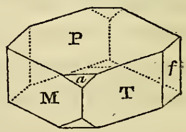
Fig. 4.



The lateral edges from *a* to *a*, Fig. 1, are always replaced, sometimes by a tangent plane, inclining equally upon the two adjacent lateral planes, but most frequently by two planes, each of these being again followed by another very narrow plane, leaving scarcely any remaining portion of the primary faces; thus imparting to the crystals an oval or cylindrical shape, and, in connexion with the low pyramids of the summits, rather a barrel-shaped appearance. Fig. 3 represents one of the crystals of occasional occurrence with the bevelment of the edges, the decrement of the summit being complete and showing the whole of the lower pyramid, where it unites with the matrix. Fig. 4 represents another of these crystals with the additional planes. The dotted lines on these figures are intended to show deep grooves, or striæ, which extend longitudinally along the faces of the crystals, or parallel with their prismatic axes, and probably indicate the faces of cleavage in this direction. This cleavage, however, is obtained with great difficulty, as is the case with this mineral from other localities. There are also transverse striæ on some of the crystals parallel with the opposite cleavage, appearing very rarely upon the acuminating faces. The larger crystals, which are nearly of the size of the last figure, are of a grayish white color and nearly opake; the smaller are colorless and transparent. These crystals are highly axotomous, the folia separating with great readiness parallel to P, and the faces of this cleavage present a high pearly lustre, though not superior to that of some of the faces of crystallization in the same direction. Faces M, M vitreous, some smooth and shining, others roughened and dull. Faces *a*, *a* of the pyramids, with few exceptions, perfectly smooth and brilliant, pearly. The proportion between the length and breadth of these crystals is variable; but in the smaller and most perfect ones it is not less than four to one.

The other crystals of apophyllite alluded to, are of greater dimensions, measuring frequently an inch through the vertical axis of the prism. They are derived from a square prism, scarcely distinguishable, in the comparative length of the lateral and basal edges of the crystal, from a cube, and present only simple replacements on the solid angles, by perfectly smooth and brilliant planes of a high pearly lustre, resembling specimens in the writer's collection from Iceland.* The lateral faces are frequently composed of curved laminæ; and the mineral sometimes presents compound varieties, consisting of lesser individuals, flattened or compressed, so as to show only portions of their planes, or sections of smaller crystals, which have been prevented, by their mutual contact, from assuming their full and perfect proportions. These are united by similar parts, so as to have their similar faces in parallel position with each other. The surfaces of several of the larger crystals are free from these combinations, having bright polished planes, measurable by the common goniometer. The amygdaloid to which they are attached, abounds in vesicular cavities, some of which are filled by green earth and hollow nodules of chalcedony.

Fig. 5.



Heulandite. (Hemi-prismatic Kouphone-spar, M.)—The individuals of this species present the primary form, replaced on the obtuse solid angles by very minute scalene triangular planes, resembling the subjoined Fig. 5, and

* I have in my possession, (obtained in Nova Scotia last year,) several large transparent crystals of this mineral, some of which are replaced on the solid angles by *three* planes, as in the case of analcime; a modification which I do not find mentioned as having before been observed in the crystals of this species.

being usually of nearly the same size. Color, pure white; lustre of P, pearly; secondary planes a, f, vitreous; but the faces M, T possess a dull, waxy, or opalescent lustre, which I have not before observed in the crystals of this mineral, apparently, however, confined to the surface; and the same faces are more or less curved or hollowed, so as not to admit of measurement by the goniometer. Some of these faces form a regular uniform curve, inclining equally towards the terminal planes P, obliterating the small replacements a, f, which are usually very distinct.

Stilbite. (Prismatoidal Kouphone-spar, M.)—The crystals generally are not well defined, the masses consisting of pure white pearly folia, forming sheafs or fasciculated groups, showing at their free extremities, only imperfect crystalline faces of a low pyramid, inclining from the solid angles of the prism. Some of these masses, composed entirely of the stilbite, are of a globular form, presenting on fracture, a radiation of fibres from a common centre. A few small, but very brilliant, and perfectly transparent crystals of this mineral, were however seen in some of the vesicular cavities of the amygdaloid, exhibiting the primary prism, compressed into low six-sided tables, the four replacements at the summits of the prism being narrowed down so as to form regular beveled edges upon the four corresponding sides of the tables, producing a form nearly similar to Fig. 6, taken from the System of Mineralogy by Beudant, Vol. 2d, plate x, fig. 62.

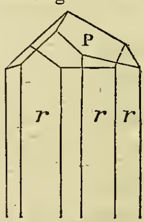
Fig. 6.

Mesotype of Phillips. (Peritomous Kouphone-spar of Haidinger.)—A nest of the crystals of this mineral was met with in the form of small implanted individuals, occupying the cavity of a mass of quartz and chalcedony. They are in elongated rhombic prisms, colorless, transparent, and of a glassy lustre; but a few of them have a silky, fibrous appearance, similar to some of the specimens met with in the more ancient lavas of Vesuvius. They do not form groups of united, divergent crystals.

Rhombohedral Quartz.—I was so fortunate as to find among this collection, besides several of the sub-species of this mineral, two or three specimens exhibiting the primary obtuse rhomboid in great perfection, and of considerable size; some of them measuring half an inch across their planes. They present highly polished surfaces, are transparent and colorless; and it is evident, I think, that they cannot be regarded as *pseudomorphs* of any other mineral, from the agreement in the value of their angles as measured by the goniometer, compared with those of the obtuse rhomboid established as the fundamental form of the species, as well as from the fact that the crystals are imbedded in cacholong, which now occupies the interior of the geodes. If pseudomorphous, the mineral of which they are imitative must have been removed so as to admit of a subsequent infiltration of the cacholong. It is more probable that the quartz and cacholong were formed at the same time, the latter affording a soft matrix in which the crystalline molecules could freely arrange themselves, according to the laws which governed them.

Two other modifications of rhombohedral quartz were met with among these specimens, of comparatively rare occurrence. In one, the primary rhomboid, by a very deep truncation of its lateral solid angles, has given rise to long six-sided prisms, terminated by trihedral summits, there being no triangular replacements upon the upper edges of the rhomboid by which the usual six-sided pyramids are produced. See Fig. 7. On some of the rhomboids, however, which do not present any portion of the faces parallel with their axes, we may observe the small triangular planes which finally produce the six-sided pyramids. The terminal primary planes P, are smooth and bright, while the elongated faces *r*, are curved and roughened by transverse striæ. Sometimes the usual six-sided prisms, terminated by similar pyramids, have their *alternate* lateral solid angles replaced by small rhombic planes, inclining equally upon the sides of the prism, producing the quartz *rhombifère* of Haüy. The sides are also striated parallel with their edges of combination with the faces of the pyramids. This author, (Traité de Minéralogie, tome second, p. 413,) describes these rhombs as existing *only* on the alternate angles, but in the later works of Mohs, Beudant and others, they are figured also upon the intermediate angles, being always represented as covering but a very small portion of the acuminating pyramids. According to Phillips, the "Bornholm diamonds" afford the most perfect examples of this modification.

Fig. 7.



Green Chalcedony and Heliotrope.—This first mentioned mineral is of a deep serpentine green color. It breaks with a conchoidal fracture, disclosing in the centre of the mass, blood red spots of jasper, and thus constitutes the heliotrope. There are spots also of a lighter green, and bluish white chalcedony, interspersed with the deeper ground, which, if polished, would render the specimens highly ornamental in jewelry.

Ribbon Agate and Moss Agate.—These two interesting varieties appear in the same specimens. The branching fibres or dendrites of the latter, of a brown or reddish brown color, are imbedded in a deep ground of transparent blue and white chalcedony, the white chalcedony appearing like a delicate cloud passing through the mass, while the former is produced by parallel zigzag lines of a pure milk white chalcedony, alternating with narrow stripes of the same blue ground;—the parallelism forming a beautiful border to the specimens, and enclosing the curious moss-like ramifications which are characteristic of this variety. In one specimen, the green chalcedony has assumed the branching form, and is freely distributed through the same ground of blue and white. If polished, these several varieties will vie in beauty with the finest oriental specimens. They are usually more or less accompanied by masses of pure opake white chalcedony, and also by a stalactical, botryoidal variety of several shades of color, interspersed with quartz crystals, and attached to portions of the trap.

Cacholong.—This variety forms thin crusts upon the surfaces of the fragments of quartz, and fills the space in which crystals of the latter have been formed. It presents the common characters of opacity and adhesiveness to the tongue. It enters into the composition of a coarse ribbon agate.

Chlorophæite.—Small globular masses, soft, of a greenish color, translucent when first broken, and presenting a conchoidal fracture, occupy the vesicular cavities of the same amygdaloid which forms the gangue to the apophyllite before described. It is sufficiently distinguished from chlorite or green earth, and precisely resembles this mineral from Scotland. The opinion of most mineralogists is, that this mineral is only a variety of some other species, or the remains of some other, which has undergone decomposition. I am led to regard the latter opinion as the true one in the present case, from the occurrence of small granular concretions of what appears to be zeolite in the centre of those masses which have not entirely disappeared; though the infusibility of the decomposed mineral before the blowpipe, would seem to show that some of the ingredients of the zeolite have passed away. Shepard regards the mineral as decomposed mesotype.

In breaking some of the masses of quartz found in this collection, I was struck with the singular opalescent and waxy appearance of a fibrous and radiated mineral, which was at first supposed to be stilbite or mesotype, and which forms veins and globular knots within the quartz. Its characters before the blowpipe, soon satisfied me that it could not be identical with either of these species or with any other of the Kouphone-spars; nor am I acquainted with any other substance to which it bears any near resemblance in its general characters. It may prove to be a new species; but the absence of any regular crystalline faces in the specimens, compels me, thus far, to rely solely upon other peculiarities for the determination of its character. Of these, I have drawn up a description, which, however, I have thought best not to publish, until I am enabled to add the results of an analysis of the mineral now being made by my friend, Mr. Hayes, which will be in season for the next No. of the American Journal of Science.

Art. XXI.—*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. I.—*Habits of the Naiades.*

The operations conducive to the life, sustenance, and propagation of the bivalve mollusca inhabiting fresh waters, are usually carried on beneath the mud and sand, at the bottom of either deep or rapid streams, beyond the reach of human observation. Owing in part to this circumstance, but perhaps more to the fact that their testaceous coverings have attracted greater attention than the anatomical and physiological characters of the animals, their habits are at present very imperfectly understood.

In Vol. xxvi, p. 117, of this Journal, I advanced the doctrine that these animals are androgynous, and not hermaphrodite, as was usually maintained; also, that the sex of an individual of many of the species is indicated with certainty by the contour of the shell.

This view of the subject has, I believe, borne the test of examination, at least in our own country; for, so far as I am informed, it is sustained by every American naturalist who has had opportunities for careful and extensive observation. It holds true in respect to the following species found in the waters of the western states, the animals of which I have repeatedly dissected at different seasons of the year, and under various circumstances and conditions, without finding in any instance an exception—to wit:

Unio Æsopus	of *Green.*	Unio Rangianus	of *Lea.*
" alatus	" *Say.*	" sulcatus	" "
" lapellus	" "	" tenuissimus†	" "
" nasutus	" "	" zigzag‡	" "
" ovatus	" "	" foliatus	" *Hildreth.*
" compressus	" *Lea.*	" orbiculatus	" "
" capsæformis	"	" parvus	" *Barnes.*
" circulus	" "	" tuberculatus	" "
" iris	" "	" luteolus	" *Lam.*
" irroratus	" "	Alasmodonta calceola§	of *Lea.*
" lævissimus	" "	Anodonta decora	" "
" multiplicatus	"	" Ferussaciana	" "
" multiradiatus	"	" plana	" "
" pileus*	" "		

In several of the above species, the difference in the outlines of the shells in the two sexes is slight, and might escape the attention of a hasty observer, yet it is permanent and invariable in whatever locality they are found.

There are certain other species in which the sex is not attended with any corresponding difference in the shell, at least so far as I have been able to discover. It may however yet be found upon further examination, that some minute difference has been overlooked. Of this character are the following:

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* The *pileus* of Lea, and the *personatus* of Say, are the male and female of the same species.

† The female is the *U. velum* of Say.

‡ The *U. donaciformis*, is the female of this species.

§ The *Margaritana deltoidea* of Lea is the male, varied from the usual form and size by the peculiar influence of the waters of Mill Creek, near Cincinnati.

Unio	asperrimus	of *Lea.*	Unio	crassidens	of *Lamarck.*
"	Kirtlandianus	" "	"	obliquus	" "
"	coccineus	" *Hildreth.*	"	verrucosus	" *Barnes.*
"	phaseolus	" "	"	melancorus	" *Rafinesque.*
"	crassus	" *Say.*			

Besides the species which I have referred to, our western waters abound with many others, which I have not examined with sufficient attention to allow me to decide with certainty whether their sexes are marked with a difference in the form of their shells, or whether they are exceptions to this rule.

While making these examinations a few years since, I discovered in a number of instances a peculiar appendage to the young bivalves that I have not seen noticed by any author.

On raising these animals from their beds at the bottom of the streams, a small silky filament could frequently be seen issuing from between the valves of the shell, and on tracing it to its origin, it was found to arise from the margin of the animal immediately behind the base of the muscular process, which is usually termed the foot. As the other extremity of this filament was apparently attached, in a few cases, to some portion of the animals of older individuals of the same species, or perhaps to the inner surface of their shells, I was led to conclude that there exists, for a certain period of time, a connection between the old and the young of the Naiades, analogous to the umbilical connection of the mammalia. In one instance I supposed that I had succeeded in tracing out a perfect connection of this kind between a young Unio crassus not half an inch in length, and a full grown specimen. The filament that united them appeared to pass to the animals of both the old and young between the edges of the valves.

On a subsequent occasion, I saw a female U. cylindricus throw off the contents of her oviduct in jets, which I watched till they were dissolved and broken, so that each individual ovum was left to float in any direction the stream might force it. From this circumstance, it was evident that no umbilical attachment could be subsequently formed between the mother and her progeny, and therefore my conclusions must have been erroneous.

The matter remained with me in this state of uncertainty until last autumn, when the low stage of water and the protracted hot weather, enabled me to pursue my researches more extensively and with better success than on former occasions.

In company with my friend J. G. Anthony, of Cincinnati, we found great numbers of young Uniones on a sand-bar in the Ohio river, near that city. The water was clear, rapid, and about eighteen inches deep, offering the most favorable circumstances for the accomplishment of our purpose. The young were generally imbedded in sand and pebbles to the depth of three or four inches, and when carefully raised from their retreats were always found to be furnished with the filament above described. On tracing out the extremity, remote from the body, we discovered it to be attached indiscriminately to pebbles, stones, the shells of older specimens, or other fixtures. The purpose it is destined to accomplish, instead of being an umbilical connection with the mother, as I formerly supposed, is evidently that of a cable, to anchor the young in safety in a favorable locality, at an age when they are unable to do it by other means. It is in fact a byssus, similar in many respects to that with which the Chama and certain other bivalves are furnished, and by means of which they adhere to other bodies.

Fig. *a*.

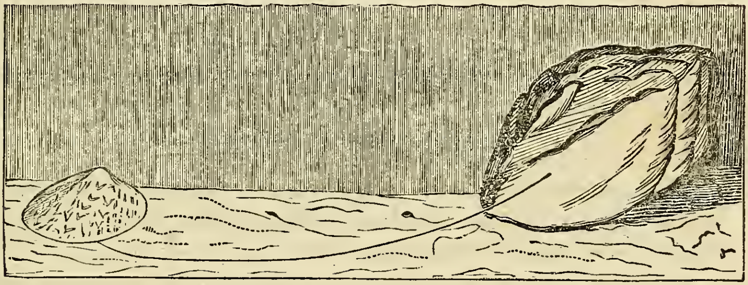

Fig. *b*.

Fig. *a* represents a vertical section of the river, exhibiting a young U. zigzag raised out of its bed, but still attached to a stone.

Fig. *b*, the origin of the byssus at the base of the foot of the animal.

At what age it is formed in our young Naiades, I am unable to decide. I have discovered it to exist in many instances when they had not yet formed the first concentric line of growth on their shells, and therefore conclude that they attach themselves to some fixture, soon after they are ejected from the oviduct of the mother.

It is probably continued, unless accidentally destroyed, until the animal attains strength sufficient to retain its position by grappling the sand and pebbles with its extended and curved foot.

The length of this byssus when unextended, is from four to six inches; the size that of the finest sewing silk, and the strength is so great that it will resist the force of the strongest current of water, even after the animal is raised out of its bed.

The species we found thus attached in this locality, were principally the U. zigzag, elegans, dehiscens, ebenus, crassus, foliatus, pyramidatus, crassidens and gibbosus. I believe, however, that every species has the power of forming a byssus when occasion requires it.

Cleveland, March 10, 1840.

MISCELLANIES.

DOMESTIC AND FOREIGN.

Bibliographical Notices.—*Brief notices of recent Botanical works, especially those most interesting to the student of North American Botany.* [Communicated.]

1. *DeCandolle, Prodromus Systematis Naturalis Regni Vegetabilis, &c., Pars 7ma. Sectio posterior.* (*Paris*, 1839).—The second part of the 7th volume of DeCandolle's Prodromus—with which our notices may appropriately commence—was published at the very close of the last year, and comprises the following orders, viz. *Stylideæ*, *Lobeliaceæ*, *Campanulaceæ*, *Cyphiaceæ*, (a very small order, founded on the Cape genus Cyphia, and here first proposed by Alph. DeCandolle,) *Goodenovieæ*, *Gesneriaceæ*, *Napoleoneæ*, *Vaccineæ*, *Ericaceæ*, *Epacrideæ*, *Pyrolaceæ*, *Francoaceæ*, and *Monotropeæ*. Of these, the Lobeliaceæ, Campanulaceæ, and Cyphiaceæ were elaborated by Prof. Alphonse DeCandolle, the well known son of the distinguished author; the Vaccineæ by Prof. Dunal of Montpelier; and the tribe Ericeæ (the *Heath-tribe*) was prepared by Mr. Bentham. It

will be observed that DeCandolle has disposed the Ericaceæ nearly in the manner first proposed in the *Théorie Elémentaire*, considering the Vacciniceæ, Monotropeæ, Pyrolaceæ, &c., as so many distinct families; a view, however, which will not probably be ultimately adopted. Among the uncertain or little known Ericaceous plants, DeCandolle has introduced the genus *Pickeringia* of Nuttall (which was founded upon Cyrilla paniculata of the same author, published in the fifth volume of this Journal:) this however has been long since ascertained to be a species of Ardisia, which belongs to a very different order; and Mr. Nuttall has accordingly recently dedicated to Dr. Pickering a curious Leguminous plant from California. The genus Galax, DeCandolle has appended to Pyrolaceæ, (tribe Galaceæ,) a view which appears to be confirmed by an unpublished plant from the mountains of North Carolina, which, in compliment to an assiduous and well-known American botanist, will bear the name of *Shortia galacifolia.*

The prior portion of the seventh volume (published in 1838) as well as the whole of the fifth (1836) and sixth, (1837,) is exclusively devoted to the immense family of the *Compositæ,* (the class Syngenesia of Linnæus,) which fills more than seventeen hundred closely printed pages, the immediate preparation of which occupied the indefatigable author for seven years! We may take this family as a fair example of the vast increase in the number of known species within the last eighty years, or even a much later period, as a large proportion of this increase is due to the discoveries of the last ten or fifteen years. The whole number of Syngenesious plants described by Linnæus in the first edition of the *Species Plantarum*, (published in 1753,) including the few Compositæ referred to other classes, is five hundred and fifty five, which is about one hundred and fifty less than the now described species of the single genus Senecio. We have not time nor space to enumerate the species of the order in succeeding systematic works, so as to show the progressive increase. Suffice it to say that the whole number known to Linnæus and published during his lifetime cannot exceed eight hundred species, while the number described by DeCandolle is in round numbers about 8700, which are disposed in eight hundred and ninety three genera. If to these we were to add the species which have been since published, or are being published in works now in progress, and also the very numerous unpublished species which exist in all the large collections, making at the same time reasonable allowance for nominal species, the number of Compositæ at present known would scarcely fall short of ten thousand, which considerably exceeds the whole number of both flowering and flowerless plants described by Linnæus or his contemporaries. Of the eight thousand seven hundred species given by DeCandolle, more than three thousand are described for the first time in this work. In the general disposition of the order, the clear and simple classification of Lessing is to a great degree adopted. It is first divided into three great series, viz.

1. TubuliflORÆ; those with the perfect flowers tubular and regularly 5- (or rarely 4-) toothed.
2. Labiatifloræ; those with bilabiate, or 2-cleft, perfect flowers.
3. Liguliforæ; which have all the flowers strap-shaped.

The first series includes about four fifths of the whole family, which are arranged in five tribes, viz. *Vernoniaceæ*, *Eupatoriaceæ*, *Asteroideæ*, *Senecionideæ*, and *Cynareæ*. The second series consists exclusively of the *Mutisiaceæ* and the *Nassauviaceæ*, chiefly South American plants; a single species of Chaptalia is, we believe, the only North American representative. The third series, comprising the *Cichoraceæ*, so readily known by their milky juice, and by having all their florets ligulate, contains many North American representatives.

So many orders or separate genera of Monopetalous plants have been the subjects of recent monographs, and much valuable assistance is also engaged for the ensuing portions of the Prodromus, that several volumes may be expected at no very distant period. It may not be improper to state that Mr. Boissier of Geneva is engaged in the preparation of the *Plumbagineæ;* Mr. Duby of Geneva will prepare the *Primulaceæ;* Prof. Dunal of Montpelier, the *Solaneæ;* Mr. De Caisne of Paris, the *Asclepiadeæ;* and Mr. Bentham, the *Scrophularineæ* and *Labiatæ*.

2. *Endlicher, Genera Plantarum secundum Ordines Naturales disposita*, (Vienna, 1836—1840).—This is one of the most important works of the age; and we are anxious to make it more generally known to the botanists of this country. It is not too much to say, that without this, and Lindley's Introduction to the Natural System, (or some equivalent work,) no person who does not possess the advantage of a large library and an extensive general collection of plants, can obtain any correct idea of the present state of systematic botany. The work is published in parts, of eighty pages each, in an imperial octavo or a kind of oblong quarto form, closely printed in double columns. The eleventh fasciculus, which is the last we have received, reaches to the eight hundred and eightieth page; but probably two or more additional numbers have by this time appeared. It is stated in the original announcement that the work will not exceed ten or twelve numbers; we imagine, however, that four or five additional numbers will be required for its completion. It commences,

like the Genera Plantarum of Jussieu, with the plants of simplest or lowest organization, (*Thallophyta*, Endl. ;) a plan which is now the most common and perhaps the most philosophical; but which is attended with many practical inconveniences to the tyro.

The first edition of the *Genera Plantarum* by Linnæus, was published at Leyden in the year 1737; the second and third were published at the same place, the one in 1742, the other in 1752; the fourth and fifth were published at Stockholm; the latter (termed the sixth in our copy) in the year 1764, which is the last by Linnæus himself, is the edition generally cited, and was reprinted at Vienna in 1767. This last Stockholm edition forms the excellent model of all the succeeding editions, as they are termed, edited by various authors. It comprises one thousand two hundred and thirty nine genera, which in an appendix are reduced as far as possible to their proper natural orders. The first edition after the death of Linnæus is, we believe, that of Reichard, published at Frankfort in 1778, about the same time with the edition of the *Systema Plantarum* by the same author. To this succeeded the edition by Schreber, (published also at Frankfort, 1789—1791, in two volumes,) who is chiefly famous for having in this work changed all the unclassical names of Aublet and others for new ones made according to the Linnæan canons. Succeeding authors in plucking these borrowed plumes have despoiled him of some rightful feathers; as in the case of the genus *Brasenia*, for which most botanists have retained Michaux's name, Hydropeltis, which was published a dozen years later. The number of genera is here increased to one thousand seven hundred and sixty nine. About the same time (1791) an edition was published by Hænke at Vienna, which is apparently carefully digested. The latest edition of the Genera Plantarum which bears the name of Linnæus, and is arranged according to the artificial system, is that of Sprengel, published at Göttingen in 1830 and 1831, (2 vols. 8vo.) which is the latest complete work in which the known genera are characterized. He gives the date of the publication of each genus, and references to the principal figures. The whole number of genera described is four thousand one hundred and fifty nine.

The *Genera Plantarum secundum Ordines Naturales disposita* of the immortal Jussieu, with which a new era in botany commenced, appeared in the year 1789. This work has never been reprinted in France, and but once out of it, and is now very scarce. Until the commencement of Dr. Endlicher's work, a period of about half a century, it has remained the only Genera Plantarum according to the natural system. There is one living botanist upon whom the task of preparing a new Genera of Plants would seem most appropriately to devolve; but since it cannot be expected from that quarter, we are glad it has been undertaken, and we may almost say completed, by so learned and careful a botanist as Dr. Endlicher. The only fault we have to notice is, that there is no mode of distinguishing directly the generic characters which are compiled altogether from preceding authors, from those drawn from the plants themselves. An author can only be considered responsible for the latter; yet unless there be some means of distinguishing those which have been verified from the remainder, he becomes somewhat implicated in the mistakes of his predecessors. Dr. Endlicher being scarcely less distinguished as a classical scholar than as a botanist, this work is a perfect model of classical style.

Simultaneously with this work, which it is in part intended to illustrate, the author is publishing an *Iconographia Generum Plantarum.* It appears in quarto parts, with about twelve uncolored plates in each, executed in a very superior manner, with full analyses, which leave nothing to be desired in this respect. Seven or eight parts are already published. It is the cheapest illustrated work of the kind with which we are acquainted, and at the same time one of the very best.

3. *Hooker, Flora Boreali-Americana, or the Botany of the Northern parts of British America, &c., part XI,* 1839. (*London.*)—The eleventh part of this work has just reached us; and as the twelfth and concluding portion may soon be expected, we hope to give in the following number of this Journal a more particular notice of Sir Wm. Hooker's most important and extensive labors in North American botany. For the present, we may merely state that the eleventh fasciculus comprises the Orchideous, and the Irideous and Cyperaceous plants, and a portion of the Grasses. Beautiful figures are given of *Platanthera obtusata, P. orbiculata,* and *P. rotundifolia;* also of a true *Epipactis!* from Oregon, (and we believe there is another in Texas,) of *Spiranthes gracilis, S. decipiens,* (a new species with just the habit of Goodyera pubescens,) *Listera convallarioides,* (the true one,) *Cypripedium passerinum,* and of twelve mostly new *Carices.* The account of the genus Carex is by Dr. Boott, who enumerates one hundred and fifty-eight species as natives of British America, (including Oregon, quite to the border of California,) of which nineteen are described as new.

4. *Hooker and Arnott, the Botany of Capt. Beechey's Voyage, &c. Part IX,* 1840. (*London.*)—This work has extended to four hundred and thirty-two quarto pages, and another fasciculus will perhaps complete the work, but of this we are uncertain. The number of plates

already cited is ninety-nine, of which eighty-nine are published. The plants collected in Capt. Beechey's voyage at Kotzebue Sound and California, (the only places in North America where collections were made,) were noticed in an early part of the volume; but in a supplement, which nearly occupies the seventh, eighth, and ninth parts, the Californian collection of the late Mr. Douglas is described, with the addition of a smaller collection made in what is called the '*Snake Country*,' which name is given to the prairie region between California and the Rocky Mountains, through which Snake River, or Lewis River, holds its course. Among the plates given in the present fasciculus, the most interesting are that of *Nuttallia cerasiformis*, Torr. Gr. (a very remarkable Rosaceous plant,) *Calycanthus occidentalis*, Hook. Arn., and *Lewisia rediviva*, Pursh, which singular plant is at last fully described and illustrated. It was brought to the United States by Capt. Lewis many years ago; it is so tenacious of life, that the roots brought by him to Philadelphia, without care, being intended only as specimens, vegetated and grew freely when placed in the earth, and the same thing took place with specimens sent to London by Douglas; it appears to abound on all the upper branches of the Oregon, where the roots are an important article of food with the Indians; yet it is only very recently that sufficient specimens have been obtained to complete the very imperfect account of the plant given by Pursh. This had however been done in part by Mr. Nuttall, from a specimen brought by Mr. Wyeth, from which a figure was made for the Journal of the Academy of Natural Sciences of Philadelphia.

5. *The Genera of South African Plants, arranged according to the Natural System; by Wm. Henry Harvey, Esq.* (*Cape-Town*, 1838. pp. 429, 8vo.)—This volume was written, printed in very handsome style, and published, at the Cape of Good Hope. It was prepared, not, as we might suppose, for the purpose of making Cape plants better known to European botanists, but for the use of the students and lovers of flowers at the Cape! It is arranged, moreover, according to the Natural System, and is throughout a work of genuine science. Truly, if popular botanical works, based on the Natural System, are deemed most advantageous for students at the Cape of Good Hope, we may indulge the expectation that this method will in due time be universally adopted in Europe and the United States. Mr. Harvey, who while occupied with his duties as Colonial Secretary, has been enabled to do so much for the botany of that rich and interesting region, both by his own researches and by encouraging the labors of others, was requested to recommend some introductory

work on botany. Had a mere introduction to the elements of the science alone been needed, the desideratum might easily have been supplied. "But I soon found," says Mr. Harvey, "on cross-questioning, that something very different was required. One lady told me that she knew already what 'calyx, corolla, stamens, and pistils, and all that' meant; and another had penetrated the mystery of Monandria, Diandria, &c., and did not want to be told that over again; what they desired, was a book in which they could discover the names of every plant that struck their fancy in rambling through the fields; in short, a *Flora Capensis*. Here I found myself completely at fault, for there seemed little use in recommending the Flora of Thunberg, or the more ancient writings of Burmann; for even could they be procured, which would not be without much difficulty, they would have proved perfectly useless to my lady friends, who, not being blue-stockings, could have derived little instruction from the crabbed Latin in which they are written." Mr. Harvey then conceived the idea of writing a Flora Capensis; but it at once occurring, that such a work must consume a long series of years in preparation, he decided upon rendering that more prompt, though less complete assistance, which a work like the present is calculated to afford. The *Genera of South African plants*, is the result of this determination; for which the author deserves the thanks, not only of the *lady friends*, whose benefit he had chiefly in view, but of all the cultivators of botanical science. Although much more time would be required for its preparation, the work would have been more valuable had Mr. Harvey placed still less dependence on preceding authors, and drawn his characters in every practicable instance, from the plants themselves; but only those who are accustomed to prepare their works in this manner, are aware of the vast amount of labor it involves. The general plan of the work, as the author informs us, is taken from Beck's Botany of the Northern and Middle States of North America, and Nuttall's Genera of North American Plants; in the arrangement and characters of the orders, Dr. Arnott has chiefly been followed. The number of genera described is one thousand and eighty-six, distributed under one hundred and thirty-five orders. Many South African genera have been published in still more recent general works or particular memoirs, or in those which had not reached the Cape in time to be employed by Mr. Harvey, so that the number of Cape genera may be safely estimated at one thousand two hundred.

6. *Presl, Tentamen Pteridographiæ, seu Genera Filicacearum præsertim juxta venarum decursum et distributionem exposita.* (*Prague*, 1836, pp. 290, 8vo., *with* 12 *quarto lithographic plates.*)—

The characters derived from the venation of Ferns, which Mr. Brown has applied to the distinction of genera with the consummate skill and caution for which he is so greatly distinguished, and which have also been largely employed by other authors, especially by Bory, Gaudichaud, Brongniart, and Schott, are in this treatise carried to an extravagant extent. Nevertheless, the work will be useful, to our botanists especially, who seldom have access to extensive libraries, or to the scattered observations on this subject in various papers and memoirs. The crowded plates comprise illustrations of nearly all the known genera; and the work may be purchased for about a dollar and a half. We may observe that the *Ragiopteris onocleoides* of Presl, is founded on a fertile frond of Onoclea sensibilis, to which a portion of the sterile frond of a very different plant had been applied in the herbarium of Willdenow. The introduction comprises a pretty full account of the organization of Ferns.

7. *Dr. Siebold, Flora Japonica; sectio prima, Plantæ ornatui vel usui inservientes; digessit* Dr. J. G. Zuccarini: fasc. 1—10, fol. (Leyden, 1835—1839, pp. 100, tab. 1—50.)—This work is, we believe, wholly arranged and prepared by Prof. Zuccarini of Munich, from notes and specimens furnished by Dr. Siebold of Leyden, accumulated during his long official residence in Japan. The admirable plates are executed at Munich: they are engraved upon stone after a peculiar method, which is now frequently employed, and are certainly not excelled in beauty or accuracy by any copper-plate engravings in the same style. The portion already published comprises only some of the ornamental or otherwise generally interesting plants; the general account of the Japanese Flora being reserved for a future part of the work. The Flora of Japan presents such striking analogies to that of the temperate part of North America as to render this work of more than ordinary interest to American botanists. To show this, we select from the forty-six species described and figured by Zuccarini, the following list, placing opposite the Japanese plant the related North American forms.

Flora of Japan.	*Flora of North America.*
Illicium religiosum,	Illicium Floridanum and parviflorum.
Kadsura Japonica,	Schizandra coccinea.
Benthamia Japonica,	Cornus florida.
Corylopsis, two species,	Hamamelis and Fothergilla.
Aralia edulis,	Aralia racemosa.
Symplocos lucida,	Hopea tinctoria.
Styrax Japonicum, &c.	Styrax, several species.
Deutzia, three species,	Philadelphus.
Schizophragma hydrangeoides, } Platycrater arguta, }	{ Decumaria and Hydrangea.

Flora of Japan.	*Flora of North America.*
Diervilla, several species,	Diervilla Tournefortii.
Viburnum tomentosum,	Viburnum lantanoides.
Wisteria (or as it should be Wistaria) Japonica, and two other species,	Wistaria frutescens.
Paulownia imperialis,	Catalpa cordifolia.

While about half the species thus far published are nearly related to (chiefly characteristic) North American plants, only eight, besides those given above, belong to genera which have no representatives in this country. The list might be greatly extended by comparisons from other sources. Thus *Hoteia Japonica* of Morren and De Caisne, (which belongs to the earlier established Astilbe, *Don*,) which was by Thunberg mistaken for Spiræa Aruncus, closely resembles our own *Astilbe decandra*, which has been more than once confounded with Spiræa Aruncus. On some future occasion we hope to make a somewhat extended comparison between the Flora of temperate North America, and that of Japan and Middle Asia.

8. *Grisebach, Genera et Species Gentianearum, adjectis observationibus quibusdam phyto-geographicis.* (Stuttgart and Tubingen, 1839, pp. 364, 8vo.)—The most useful works in natural history at the present day are monographs of separate orders, when prepared from sufficiently extensive materials; and this account of the known species of Gentianaceous plants, by Dr. Grisebach, now of Göttingen, is one of the latest and best works of the kind. The typographical arrangement, however, is not what it ought to be, and this is an important matter in books of the kind. In this respect, as in every other, the most perfect model for a monograph is Mr. Bentham's *Genera et Species Labiatarum.* Dr. Grisebach first gives the natural character of the order, in detail; then follow some interesting observations upon the anatomical and morphological structure of these plants. Two species are selected, viz. *Swertia perennis* and *Gentiana lutea;* and in these the organization of the flower is traced from the earliest period when it is distinctly visible through all its stages up to its complete development. The petals, which are united into a monopetalous corolla, are found to be originally distinct; this is now known to be the case as a general rule; so that when we say that a monopetalous corolla is formed by the consolidation of several petals, a calyx, of several united sepals, &c., our language is not the mere expression of an hypothesis, but the statement of observed facts. The conclusion is first deduced as a consequence of the theory of floral structure, and is then verified by actual examination, and thus the theory is confirmed. The stamens in their early state are distinct from the petals, although at length the filaments ad-

here to the corolla; the two carpels which form the ovary are at first distinct, and are united only at a later period. Dr. Grisebach makes some observations upon the origin of the placenta, (the organ upon which the ovules and seeds are produced,) which have an important bearing upon some interesting questions in vegetable anatomy and physiology, which are now undergoing a lively discussion, but which would not be understood by many of the readers for whom these notices are intended, without a more extended statement of the questions in dispute than we have here room to give.* In the account of the geographical distribution of Gentianaceous plants, several interesting general questions in botanical geography are discussed somewhat in detail. The whole number of species described in the work (excluding the very doubtful ones) is three hundred and forty three; of which fifty two are given as natives of North America; the latter are thus distributed among thirteen genera.

Tribe CHLOREÆ; *Sabbatia* 11 species, and a single *Chlora* (?)
" ERYTHRÆACEÆ; *Erythræa* 4, *Cicendia* 1 ?
" SWERTIEÆ; *Gentiana* 22, *Centaurella* (Bartonia, *Muhl.*) 3, *Pleurogyne* 1, *Halenia* 3, *Frasera* 3, *Swertia* 2.
" MENYANTHIDEÆ; *Villarsia* 1, *Limnanthemum* 1, [too few,] *Menyanthes* 1.

Three genera only are peculiar to this country, viz. *Sabbatia*, *Centaurella* and *Frasera*. The name of *Centaurella* is still retained for the *Bartonia* of Muhlenberg and Willdenow, which is by several years the oldest name, and should be retained, more especially since the Bartonia of Nuttall and Pursh will doubtless be merged in Mentzelia.

9. *The Journal of Botany, containing figures and descriptions of such plants as recommend themselves by their novelty, rarity, history, or uses; together with Botanical notices and information, and occasional portraits and memoirs of deceased Botanists:* by SIR WM. HOOKER, K. H., &c. (Vol. II, Nos. 9 and 10, Febr. and March, 1840.)—Hooker's Journal of Botany, which was commenced in 1834, but soon discontinued for want of sufficient patronage, is again resumed, and is to be continued in monthly numbers. Each number contains from fifty-two to fifty-six pages, and two plates, (published by Longman, Orme & Co., London, at 2s. 6d.) The contents of these two numbers are

I. *Musci Indici*, or List of the mosses collected in the East Indies by Dr. Wallich; with references to the figures of the new species

* We hope to give some notice of the recent progress of vegetable anatomy and physiology, in the ensuing number.

published in Hooker's Icones Plantarum, Vol. I, tab. XVII—XXIV. By the Hon. W. H. Harvey; to which are added those collected by Dr. Royle in the northern part of India, by J. D. Hooker, M. D., Assistant Surgeon and Botanist in Her Majesty's discovery ship Erebus.

II. On the establishment of the genus *Mouriria*, Juss., as the type of a new natural order; together with notes and observations on the structure of the genera *Lygodisodea*, *Cassytha*, and *Carludovica*. By Mr. George Gardner, Surgeon.

III. Botanical Information. Notice of the *Unio Itineraria*. Notice of Mr. Gardner's Travels and Collections in Brazil.

IV. Contributions towards a Flora of South America. Enumeration of plants collected by Mr. Schomburgh in British Guiana. By George Bentham, Esq., F. L. S.

10. *Hooker; Icones Plantarum, or Figures, with brief descriptive characters and remarks, of new or rare plants, selected from the author's Herbarium. Part VI.* (Vol. 3, part 2.) 1840.—The following North American plants are figured in this part, viz.

Cevallia sinuata, *Lagasca.*—Texas. Oplotheca Floridana, *Nutt.*—Florida, &c. O. gracilis, a new species from Texas, is described but not figured. Ceanothus papillosus, *Torr. & Gr.*—California. Grayia polygaloides, *Hook. & Arn.*—Rocky Mountains. Lœflingia Texana, *Hook.* (L. squarrosa, *Nutt.*)—Texas. Hymenolobus divaricatus, *Nutt.*—Oregon. Merimea (Bergia) Texana, *Hook.*—Texas. Trifolium obtusiflorum, *Hook. & Arn.*—California. Phaca densifolia, *Smith.*—California. Trifolium macrocalyx, *Hook.*—Texas. Stylopus vernus, *Raf.*—Kentucky. Condalia obovata, *Hook.*—Texas. Amygdalus glandulosa, *Hook.*—Texas. This part also contains the figure of a New Holland Claytonia! (C. Australasica, *J. Hook.*) which is certainly something remarkable. Many North American plants are figured in the preceding portions of this work, which is by no means expensive, and we think all our botanists and lovers of plants would find it very useful.

11. *Linnæa: Ein Journal für die Botanik in ihrem ganzen Umfange. Herausgegeben von D. F. L. Von Schlechtendal.* [The Linnæa: A Journal of Botany in all its departments, &c.]—The Linnæa, edited by Prof. Von Schlechtendal of Halle, is published every two months, and has an extensive circulation in Germany and throughout Europe. The price is about seventy-five cents per number, each of which contains from sixty to one hundred pages of original matter, and about as many more filled with notices of new works, botanical

information, &c., which is prepared with great care, and one or two plates. The numbers of each year form a very thick octavo volume: that for 1839 (of which the earlier numbers only have reached us) is the thirteenth of the series. It is doubtless one of the cheapest botanical works ever published, and as books printed in the German language pay a mere nominal duty, it may be imported at a very low price. The following is a list of the contents of the *original portion* of the three earlier numbers for 1839, viz.

1. Anatomical Researches concerning the Organs of Reproduction in *Riccia glauca*: by Prof. UNGER, of Grätz, (with a plate.)
2. De Viciis Brasiliensibus, scrips. Dr. J. R. THEOD. VOGEL.
3. Account of the Mosses collected in North America, by the late Mr. Beyrich: by E. HAMPE, Apothecary in Blankenburg. [Three or four new species are described.]
4. On Mount Slavnik in Carniolia, and its Botanical curiosities; with a description of *Pedicularis Frederici-Augusti*: by M. TOMMASINI, (with a plate.)
5. On a new *Pancratium*, and a new *Gilia*: by *C. Bouché.*
6. Remarks on the American species of *Cerasus* of the section *Laurocerasus*: by the EDITOR.
7. Notice of the late *Adelbert von Chamisso*, as a botanist: by the EDITOR.
8. On *Porella pinnata*, Linn., or *Jungermannia Porella*, Dicks. (*Madotheca Porella*, Nees.) by Prof. SCHWÆGRICHEN, of Leipsic.
9. Additamentum Filicum Mexicanarum, partim a *B. Schiedeo*, partim a cl. *Car. Ehrenbergio* aliisque collectarum. Prof. KUNZE.
10. On *Conyza Chilensis*, and *C. diversifolia*, Weinm.: by Mr. WEINMANN of Pawlosk.
11. Malpighiacearum Brasiliensium centuriam, recens. AUG. GRISEBACH, M. D.
12. De Plantis Mexicanis a *G. Shiede, M. D.*, *Car. Ehrenbergio*, aliisque collectis, &c.: by the EDITOR.
13. On the development of the spores of *Anthoceros lævis*: by Prof. HUGO MOHL, (with a plate.)
14. Observationes de *Bauhiniis* Americanis, scrips. Dr. J. R. THEOD. VOGEL.
15. Synopsis *Drabarum* Scandinaviæ, auct. A. E. LINDBLOOM.

12. *Lindley; An Introduction to Botany; third edition*, 1839. (*London*, pp. 594, 8vo.)—The first edition of this well-known and excellent work was published in 1832; the second in 1836; and the third has appeared during the last season. So great has been the increase of our knowledge within the last three or four years, partic-

ularly in vegetable anatomy and physiology, that this portion of the work has necessarily been entirely re-written, and has assumed almost a new aspect in the present edition; and even during the short period that has elapsed since its publication, many interesting discoveries have been made. The additions most worthy of notice are a new and more minute classification of elementary tissue, recently proposed by Morren; much interesting matter concerning the generation of cellular tissue; a good account of recent discoveries respecting the various forms of tissue composed of membrane and fibre combined, which are found to be of almost universal occurrence; the article on the laticiferous tissue of Dr. Schultz; and that on Raphides, concerning which there is an account in the appendix by Mr. Queckett. In the chapter on the compound organs of flowering plants, there is an account of the views of Prof. Mohl concerning the structure of endogenous stems; an analysis of Bronn's memoir on the spiral disposition of leaves; and much additional information concerning the structure and development of pollen, which will be new to most English readers. The remarks on placentation are interesting, especially as the subject is now exciting considerable attention; Dr. Lindley defends, for the most part, the doctrines of Schleiden and Endlicher on this subject. The chapter on the chemical constitution of the elementary organs, is condensed from the researches of Payen and Schleiden, which are models of chemico-physiological investigation. The most interesting additions to the subject of vegetable fertilization, are the analysis of Mr. Griffith's recent memoir on the singular structure and the impregnation of the ovulum of Santalum; and a (too brief) notice of the novel doctrines which have lately been broached by Endlicher, Schleiden, and others respecting the sexuality of plants. The opinion of Endlicher is "that what we call pollen is analogous to the spores of cryptogamic plants, and that consequently the anther is a female organ, whose contents perform an act similar to that of germination when they fall upon the stigma." The view of Schleiden, although differently expressed, amounts to the same thing; he also considering the anther as nothing but a female ovarium, and each grain of pollen the germ of a new individual. The subject is exciting much attention; and since the publication of this edition of Dr. Lindley's work, Mirbel has read a paper before the Institute of France, in which the views of Schleiden are attacked, and the commonly received Linnæan hypothesis defended. It is to be regretted that there is no detailed account of this controversy in the English language. The idea which seems to have given rise to these speculations is undoubtedly true, viz. that the organization of pollen and of the spores of cryptogamic plants is remarkably similar, and that their development takes place in the same manner. Of the remaining topics in vegetable physiology, by far the most interesting is the account of the discoveries of Prof. Schultz of Berlin, relative to the two kinds of circulation in plants which he terms *rotation* and *cyclosis*. Prof. Schultz communicated his discoveries to the Academy of Sciences at Paris, which in the year 1833 awarded to him the great Montyon prize, and undertook the publication of the memoir and an extensive and beautiful suite of drawings. Dr. Lindley's account is compiled chiefly from the abstract given in the *Comptes Rendus;* the memoir itself having only appeared during the last summer. Having had the good fortune to obtain a copy of this memoir we may perhaps give an abstract of its contents in a future number of this Journal.

Those whose knowledge of the language will enable them to consult the German works on vegetable anatomy and physiology, will find numerous interesting papers and memoirs, as well as several systematic treatises of the highest merit. Of the latter, the three following are the most important:

13. *Meyen: Neues System der Planzen-Physiologie.* (New System of Vegetable Physiology.) *Berlin,* 1837–39, 3 vols. 8vo.—The *Phytotomie* of the same author is an earlier and smaller work, (1830,) in a single volume, with a thin 4to atlas of plates.

14. *Treviranus* (*Lud. Christ.*): *Physiologie der Gewächse. Bonn,* 1835–38, 2 vols. 8vo.

15. *Link: Grundlehren der Kräuterkunde,* or *Elementa Philosophiæ Botanicæ; ed.* 2. *Berlin,* 1837, 2 vols. 8vo.—The work, although it has a double title-page, is, unlike the former edition, wholly written in the German language. Under the title of *Anatomisch-botanische Abbildungen zur Erläuterung der Grundlehren der Kräuterkunde,* Prof. Link has published three fasciculi of illustrations, with descriptive letter-press, each comprising eight large folio lithographic plates, filled with highly magnified and very beautiful anatomical dissections; and, at the age of about eighty-three, the still active author is publishing a continuation of the work, under the title of *Ausgewählte Anatomisch-botanische Abbildungen,* of which the first fasciculus has just appeared. The work is published at three Prussian thalers for each fasciculus.

16. *Proceedings of the Boston Society of Natural History. Compiled from the Records of the Society, by* Jeffries Wyman, M. D., *Recording Secretary.*

Jan. 8, 1840.—Geo. B. Emerson, Esq., President, in the chair.

The President mentioned the fact that the brown rat had been found at a distance from any habitation on Nantasket beach, burrowing in the sand, and subsisting on clams; the brown rat in these regions is not generally known to make its habitat at a distance from that of man.

Mr. Bouve stated that he had met with the nest of the brown rat in similar situations.

Jan. 15, 1840.—Geo. B. Emerson, Esq., President, in the chair.

Mr. J. E. Teschemacher made a report on Dr. Jackson's Report on the Geology of Maine. He alluded particularly to Dr. Jackson's observations on the deflection of the diluvial current from its usual N. and S. direction, as indicated by the scratches on the rocks; these deflections were attributed by Dr. J. to the influence of the surrounding elevations. There are instances in Dorchester, Mass., in which the direction of the current was nearly E. and W.

Dr. J. Wyman exhibited specimens of the *Otion Cuvierii*, Leach, taken from the bottom of a ship recently returned from India; they were found in vast numbers, and measured from three to three and a half inches in length. Dissections were also exhibited illustrating the anatomy of the organs of digestion, generation, and of the nervous system; the latter consists of a double nervous cord, extending the whole length of the animal, and on which may be seen seven ganglia; the two cords separate and form a ring around the œsophagus, and at the point of union form a ganglion or brain, from which are derived the nerves supplying the mouth and appendages. The Otion and other Cirrhopoda, are arranged by Cuvier among the Mollusks, but their nervous system approximates them to the Articulata.

Jan. 22, 1840.—Geo. B. Emerson, Esq., President, in the chair.

Dr. D. H. Storer read a letter from Mr. J. G. Anthony, of Cincinnati, in which he states that the localities in and about Cincinnati are unusually rich in species of shells. Within the circuit of ten miles around that city, there are no less than seventy species of Unio, five of Alasmodonta, six of Anodonta, thirty two of Helix, seven of

Melania, five of Pupa, six of Paludina, seven of Planorbis, four of Lucunea, two of Cyclostoma, two of Bulimus, three of Physa, two of Ancylus, besides some doubtful species. He had also found specimens of the Lymneus humilis, Say, and the Anodonta Ferussaciana.

Dr. J. Wyman exhibited a portion of the lung of a sheep, in the bronchi of which were vast numbers of parasites, a species of Filaria; they invariably occupied those portions of the bronchi most distant from the trachea, and were collected together in clusters of from ten to twenty in number. He also exhibited a dissection of the egg of a snake which had partially undergone the process of incubation. The shell was membranous, with granules of calcareous matter scattered over its surface. When the egg was first opened, the animal was living; the circulation could be distinctly seen; the head was large in proportion to the rest of the body, and its longest diameter at right angles to the trunk instead of being in the same line as in the adult.

Dr. A. A. Gould had ascertained that the Scutella referred to him at the last meeting was the S. bifissa of Lamarck. The Scutellæ have a shell extremely depressed, flat on the under surface, in the center of which is the mouth, and between the latter and the edge of the shell is the anus. The S. bifissa is so called from its two deep emarginations; the portion enclosed between the emarginations varies in its figure, sometimes projecting beyond the surrounding parts, and occasionally overlapping them. There is but one species of Scutella common on our coast, which Dr. Gould thinks is undescribed.

Feb. 12, 1840.—Geo. B. Emerson, Esq., President, in the chair.

Rev. J. L. Russell, of Chelmsford, read a paper entitled "Remarks on the Cryptogamia of Chelmsford," accompanying which were specimens for the Society's herbarium. The species referred to were as follows:

Squamaria rubina, Hoff., not mentioned in Hitchcock's catalogue of the plants of Massachusetts. This lichen is considered rare in other parts of New England. In Chelmsford it is one of the most beautiful lichens investing the surfaces of bowlders. Its synonymy, as ascertained by Mr. Edward Tuckerman, Jr., embraces Lichen chrysoleucus of Hud.; Parmelia chrysoleuca, Ach.; and Lecanora chrysoleuca, Ach. It is found uniformly on granite bowlders in intimate association with supposed to be Lecidea lapicida, Ach., which also is not found in Hitchcock's catalogue. It is best distinguished by the apothecia chiefly occurring between the areolæ, and by their being black with a margin of the same color.

Cornicularia lanata, Ach., is met with ; this plant does not appear to have been observed by any American botanist. Its co-species, C. pubescens, Ach., is to be seen on the same exposures, a fact at variance with the testimony of Acharius and other botanists.

Urceolaria scruposa, considered rare, is an inhabitant of the rocks, and is a curious and well defined lichen.

Of the doubtful genus Lepraria, two species have been detected, viz. L. chlorina, on stone-walls, and L. latebrarum, of Halsey, on bowlders, and a third doubtful one, supposed to be the L. virescens.

The large rocks afford the Endocarpum miniatum, and E. smaragdalum, while the curious E. Weberi is abundant in the brooks. Variolaria amara, Halsey and Ach., is abundant, its intense bitterness resembling quinine. This has been supposed identical with V. faginea; but they are probably two different species, only to be distinguished by minute characters. Of the Cetrariæ, there are three of the four mentioned in Hitchcock's catalogue, viz. C. lacunosa, C. ciliaris, and C. viridis. An interesting small Nephroma is somewhat abundant on the faces of small sunken stones, in sunny exposures, which Mr. Tuckerman supposes to be N. Helvetica, and identical with the plants found by him in Newton. This also adds another new species to Hitchcock's catalogue. Two species of Ramalina occur, viz. R. fraxinea, R. polymorpha, the latter common on stone walls. The Borrera furfuracea is common on the branches of the pitch pine; Acharius's variety denudata occurs with this species and can only be regarded as an *accidental* variety in which the cilia of the apothecia are wanting. A query whether the American species and the English are identical, might be set on foot. Thus Hooker says—thallus, bright greenish yellow, alike on both sides ; in the specimens found in Chelmsford, the under surface is white. Lecanora fulva, Schw., is common on old elms and oaks. Evernia prunastri of Hitchcock's catalogue, or what has been supposed to be this, has been found in company with E. vulpina, which is very common. It has not a slight resemblance to the Borrera furfuracea, and it is supposed that B. furfuracea was intended by B. purpuracea, given as its synonym. The following is the description of the Evernia prunastri; thallo albo, pallescente, lacunis dichotomo-multifidis, erecto, adscendentibus lineari alternatis planis rufoso lacunosis subtus subcuniculatis albissimis; apothecia disco rufescente.

Some interesting mosses have also been found, not inserted in Hitchcock's catalogue. A minute moss found by Edward Tuckerman, Jr. on the summit of Bear Hill, Waltham, proves to be Weissia controversa of the catalogue, and identical with W. viridula, Hedw., given as distinct. Two species of Polytrichum and a supposed new one have been found. A delicate fern, not previously seen in this section, has been found in company with the Marchantia hirsuta, Schw. It is the Aspidium fragile, Willd.; it has been found in New York in company with Asp. rhizophyllum, and in both localities its habitat is about limestone quarries.

Feb. 19, 1840.—Geo. B. Emerson, Esq., President, in the chair.

Dr. J. Wyman made a report on the Nautilus umbilicatus. The principal interest attached to this shell in common with other cephalopodous mollusks, is the question regarding the use of the chambers well known to exist in the shells of all this class of animals. They are supposed by naturalists to form a part of an apparatus by which the animal is enabled to rise and fall in the water. It is the opinion of Professor Owen that there does not yet exist sufficient evidence for concluding that the specific gravity can be altered by the apparatus in question. The calcareous structure of the syphon of the Spirula would seem to prevent the possibility of the condensation of the enclosed air or fluid by any force from without.

Dr. Storer presented the following report on "Bell's British Reptiles."

From an examination of the splendid "monograph of the Testudinata" of our author, we had a right to expect a rich treat from the pages before us; nor have we been disappointed. The "history of the British Reptiles" is written by a *true naturalist*, by one whose every page is stamped with accuracy and truth, who never finds it necessary to exaggerate in order to interest, but who seems to feel his responsibility in the statements he makes, and that his reputation is associated with the subjects he is endeavoring to elucidate.

The descriptions of each of the sixteen species which constitute the Reptilia of Great Britain, are all clear and interesting—such descriptions as satisfy the naturalist.

I will glance at some of the species. Two only of the *Testudinata*, have been found on the British coast, and these were evidently stragglers. Thus, the "Chelonia imbricata," hawk's-bill turtle, has been observed but *three times*, and of the "Sphargis coriacea," leathery tortoise, but *four specimens* have been known to be taken.

The *Lacerta agilis*, sand lizard, and *Zootoca vivipera*, common lizard, are the only Saurians noticed. The patient investigation of our author in comparing the former species with others supposed to be different, and settling its synonymes, is well worthy the attention of us all.

The *Anguis fragilis*, slow worm, is the only Saurophidian spoken of.

Singular as it may appear, but *one* of the *Colubridæ* is found in Great Britain,—the Natrix torquata, common snake; which we are here told, "inhabits most of the countries of Europe, from Scotland and the corresponding latitude of the Continent, to Italy and Sicily." The following curious anecdote is related of the manner in which they manage their prey and each other: "On placing a frog in a large box in which were several snakes, one of the latter instantly seized it by one of the hinder legs, and immediately afterwards another of the snakes took forcible possession of the fore leg of the opposite side. Each continued its inroads upon the poor frog's limbs and body, until at length the upper jaws of the two snakes met, and one of them in the course of its progress slightly bit the jaw of the other; this was retaliated, though evidently without any hostile feeling; but after one or two such accidents, the most powerful of the snakes commenced shaking the other, which still had hold of the frog, with great violence, from side to side against the sides of the box. After a few moments' rest, the other returned the attack, and at length, the one which had last seized the frog, having a less firm hold, was shaken off, and the victor swallowed the prey in quiet. No sooner was this curious contest over, than I put another frog into the box, which was at once seized and swallowed by the unsuccessful combatant." Our author, immediately after relating this anecdote, observes: "The frog is generally alive, not only during the process of deglutition, but even after it has passed into the stomach. I once saw a very small one which had been swallowed by a large snake in my possession, leap again out of the mouth of the latter, which happened to gape, as they frequently do immediately after taking food. And on another occasion, I heard a frog distinctly utter its peculiar cry several minutes after it had been swallowed by the snake." This reminds us of the anecdote related by Harlan,* who, speaking of the tenacity of life exhibited by the *Rana clamata*, observes: "A dog of Mr. Bartram's having accidentally swallowed one of these animals, it was observed to struggle and cry piteously for at least *half an hour*, to the great diversion of the spectators, and no small confusion of the dog, who was at a loss to comprehend this species of intestinal eloquence." Like many of our snakes, the *torquata* may be easily tamed; our author remarks: "I had one many years since, which knew me from all other persons; and when let out of his box, would immediately come to me, and crawl under the sleeve of my coat, where he was fond of lying perfectly still, and enjoying the warmth. He was accustomed

* "Descriptions of several new species of Batracian Reptiles, with observations on the Larvæ of Frogs. By Richard Harlan, of Philadelphia." This Journal, Vol. x, p. 63.

to come to my hand for a draught of milk every morning at breakfast, which he always did of his own accord; but he would fly from strangers, and hiss if they meddled with him." Many of the members of this society undoubtedly remember having seen, several years since, accounts in the newspapers of snakes being carried to Ireland, and that they were increasing there. The facts connected with this attempt to introduce these animals into Ireland, are thus clearly shown by a letter to the author from Mr. Thompson. "In this order (*Ophidia*) there is not now, nor I believe ever was there, any species indigenous to Ireland. In the Edinburgh New Philosophical Journal for April, 1835, it is remarked, 'We have learned from good authority, that a recent importation of snakes has been made into Ireland, and that at present they are multiplying rapidly within a few miles of the tomb of St. Patrick.' I never," proceeds Mr. Thompson, "heard of this circumstance until it was published, and subsequently endeavored to ascertain its truth, by inquiring of the persons about Downpatrick, (where the tomb of St. Patrick is,) who are best acquainted with these subjects, not one of whom had ever heard of snakes being in the neighborhood. Recollecting that about the year 1831, a snake, (Natrix torquata,) immediately after being killed at Milecross, was brought by some country people in great consternation to my friend, Dr. I. L. Drummond, I thought this might be one of those alluded to; and recently made enquiry of James Cleland, Esq., of Ruth Gael House, (County Down,) twenty-five miles distant in a direct line from Downpatrick, respecting snakes said to have been turned out by him; I was favored by that gentleman with the following satisfactory reply. 'The report of my having introduced snakes into this country is correct. Being curious to ascertain whether the climate of Ireland was destructive to that class of reptiles, about six years ago I purchased half a dozen of them in Covent Garden market, in London; they had been taken some time, and were quite tame and familiar. I turned them out in my garden; they immediately rambled away; one of them was killed at Milecross, three miles distant, in about a week after its liberation, and three others were shortly afterwards killed within that distance of the place where they were turned out; and it is highly probable that the remaining two met with a similar fate, falling victims to a reward which it appears was offered for their destruction.' "

Besides the *Natrix torquata*, but one more of the *Ophidia* is noticed; the *Pelius Berus*, common adder; which, to use the words of our author, "is the sole British representative of any of the poisonous groups of serpents, and indeed the only poisonous reptile indigenous to this country."

The history of the *Rana temporaria*, common frog, is very interesting; the changes which take place in its development from the *ovum* to the perfect animal, are pointed out with a clearness which shows how well they are understood by the describer. In a pleasing anecdote, our author proves its capability of being tamed; he states that his friend, Dr. William Roots, of Kingston, informed him, "that he was in possession, for several years, of a frog in a perfect state of domestication. It appears that the lower offices of his house were what is commonly called under-ground, on the banks of the Thames. That this little reptile accidentally appeared to his servants, occasionally issuing from a hole in the skirting of the kitchen, and that during the first year of his sojourn, he constantly withdrew upon their approach; but from their showing him kindness, and offering him such food as they thought he could partake of, he gradually acquired habits of familiarity and friendship; and during the following three years, he regularly came out every day, and particularly at the hour of meal-time, and partook of the food which the servants gave him. But one of the most remarkable features in his artificial state of existence, was his strong partiality for warmth, as during the winter seasons, he regularly (and contrary to the cold-blooded tendency of his nature) came out of his hole in the evening, and directly made for the hearth in front of a good kitchen fire, where he would continue to bask and enjoy himself until the family retired to rest.

"There happened to be at the same time a favorite old domestic cat, and a sort of intimacy or attachment existed between these two incongruous inmates; the frog frequently nestling under the warm fur of the cat, whilst the cat appeared extremely jealous of interrupting the comforts and convenience of the frog. This curious scene was often witnessed by many besides the family."

The manner in which the *Bufo vulgaris*, common toad, sheds its cuticle, is described very instructively. "Having often found, among several toads which I was then keeping for the purpose of observing their habits, some of brighter colors than usual, and with the surface moist and very smooth, I had supposed that this appearance might have depended upon the state of the animal's health, or the influence of some peculiarity in one or the other of its functions; on watching carefully, however, I one day observed a large one, the skin of which was particularly dry and dull in its colors, with a bright streak down the medial line of the back; and on examining further, I discovered a corresponding line along the belly. This proved to arise from an entire slit in the old cuticle, which exposed to view the new and brighter skin underneath. Finding, therefore, what was about to happen, I watched the whole detail of this curious process. I soon observed that the two halves of the skin, thus completely divided, continued to recede further and further from the centre, and became folded and rugose; and after a short space, by means of the continued twitching of the animal's body, it was brought down in folds on the sides. The hinder leg, first on one side and then on the other, was brought forward under the arm, which was pressed down upon it, and on the hinder limb being withdrawn, its cuticle was left inverted under the arms, and that of the anterior extremity was now loosened, and at length drawn off by the assistance of the mouth. The whole cuticle was thus detached, and was now pushed by the two hands into the mouth in a little ball, and swallowed at a single gulp."

Four species of *Salamandridæ* are described in the volume before us. The history of the *Triton cristatus*, common water-newt, is very elaborate; our author has carefully made the same observations as *Rusconi*, and adds his testimony to the value of that writer's investigations with regard to the development of this species. We are here told, that *Spallanzani* supposed that the eggs when deposited, fell at once to the bottom of the water, and that "*Cuvier* asserts, that they are produced by several at a time, attached to each other like beads." Now, although *Rusconi* first published an accurate account of this process, our author had several times personally observed it before he was acquainted with Rusconi's book. It appears that the egg, instead of being carelessly dropped, is most curiously guarded. "The female, selecting some leaf of an aquatic plant, sits, as it were, upon its edge, and folding it by means of her two hinder feet, deposits a single egg in the duplicature of the folded part of the leaf, which is thereby glued most securely together, and the egg is thus effectually protected from injury."*

The *wood cuts* accompanying the descriptions are graphic and excellent; the vignettes so liberally distributed throughout the volume, must enhance its value with general readers.

In conclusion, we would recommend all who have the slightest taste for herpetology, to study this volume; and when again confined to our chamber by indisposition, may we have the good fortune to meet with a production of the "Professor of Zoology, King's College, London."

17. *Association of American Geologists.*

At a meeting held at the rooms of the Franklin Institute in the city of Philadelphia, on the 2d of April, 1840, the following gentlemen were present, viz.

* An abstract of Rusconi's memoir on the "natural history and structure of the aquatic Salamander," with an illustrative plate, may be found in No. XVII of the "Edinburgh Philosophical Journal" for 1823.

Edward Hitchcock, Amherst, Mass.; Lewis C. Beck, New Brunswick, N. J.; Henry D. Rogers, Philadelphia; Lardner Vanuxem, Bristol, Pa.; William W. Mather, Brooklyn, Ct.; Walter R. Johnson and Timothy A. Conrad, Philadelphia; Ebenezer Emmons and James Hall, Albany, N. Y.; Charles B. Trego, James C. Booth, M. H. Boyè, R. E. Rogers and Alexander McKinley, Philadelphia; C. B. Hayden, Smithfield, Va.; Richard C. Taylor, Philadelphia; Douglass Houghton and Bela Hubbard, Detroit, Michigan.

Prof. Hitchcock was appointed Chairman, and
Prof. L. C. Beck, Secretary.

It was then unanimously resolved to organize an association, to be called "*The Association of American Geologists.*"

After the transaction of business relating to the election of additional members, the time and place for holding the next annual meeting, &c., several communications were made to the Association, and discussions had thereon. The following is a brief abstract of these proceedings.

First day.—Specimens were laid on the table of quartz, phosphate and carbonate of lime, having a fused appearance, occurring in St. Lawrence County, N. Y., and some views were offered concerning the causes which have given rise to it. Remarks having been made on this subject by other members, it was referred for a full report at the next meeting of the Association.

Specimens were next presented of the sandstones of Massachusetts, exhibiting the fossil footmarks, so called, and observations made in regard to them. This subject was of so much interest as to induce the Association to appoint a committee to visit the localities and to report their conclusions at the next meeting.

After this followed a discussion on the subject of diluvial action, in which several members took part. Information was communicated concerning the diluvial grooves or scratches, which are observed in the valleys of the Hudson, Ohio, and Mississippi, the polished limestones of Western New York, the erratic blocks found in New York, Pennsylvania, &c.; and several points were suggested for future investigation.

Second day.—The first business was, a lecture on some parts of the geology of the State of New Jersey. Upon this, remarks were offered by several members; after which there was presented to the Association, an outline of the geology of the State of Michigan. The remaining part of the day was spent in free conversation on various geological topics.

Third day.—The meeting was opened by some remarks on the apparent stratification of serpentine. A locality was referred to in the

State of Pennsylvania, where that rock exhibits the appearance of being regularly stratified. Several members presented facts respecting other localities bearing upon the question of the origin, whether strictly intrusive or metamorphic, of certain belts of serpentine.

A statement was made in regard to the frequent occurrence of fossil infusoria in almost every town in New England in which primary rocks prevail. A member observed, that after the most diligent search, he had been unable to detect them in the cretaceous group. After remarks by several other members, the conclusion was, that so far as fossil infusoria are known in this country, they are confined to the primary formations.

A notice was next presented of the occurrence of the native black peroxide of copper, on the shores of Lake Superior. This was followed by remarks upon the copper ores of New Jersey.

Some observations were then made regarding the coal fields of Pennsylvania, particularly with reference to certain changes in the chemical composition of the coal as we proceed from the east to the west. Statements corroborating the general correctness of the views presented, and extending the same to the States of Ohio and Illinois, were made by other members.

Some suggestions were next offered concerning the fertilizing properties of mica. These led to some remarks on the cause of the fertilizing powers of the green sand, the peroxide of iron, &c., when it was

Resolved, That the subject of mineral manures be open for discussion at the next meeting, and that the members be requested to note all such facts as may contribute to its elucidation.

Professor Silliman was then unanimously elected chairman for the next meeting, and the present chairman was requested to open that meeting with an address.

The Secretary was requested to prepare an abstract of the proceedings of this session of the Association, for publication in the American Journal of Science, and in the Journal of the Franklin Institute; when after the usual resolutions of thanks, the Association adjourned to meet in Philadelphia on the first Monday in April, 1841.

18. *Fossil Infusoria of West Point, New York.*—These depositions, which are now known to be of common occurrence in many parts of the country, were first detected in North America by Professor Bailey, of the United States Military Academy, who has noticed them in Vol. xxxv, p. 118, of this Journal. A small portion of the earth from West Point, which is composed in a great degree of these minutest of fossils, reached Prof. Ehrenberg about a year since, and is noticed by him in the *Account of the Proceedings, &c. of the*

Royal Prussian Academy of Sciences of Berlin, for February, 1839. He found it to contain fourteen kinds of siliceous infusory animals, viz.

Cocconema asperum, *n. sp.*
Eunotia Arcus.
" Diodon.
Navicula alata.
" amphioxys, *n. sp.*
" Suecica.
" viridis.
" viridula.
Fragillaria trionodis.
Gallionella distans.
Gomphonema paradoxum.
Spongilla lacustris? (Spongia?)
Spongia apiculata. (Tethya?) *n. sp.*
Amphidiscus Rotula. (nov. genus?)

The most predominating forms are *Gallionella distans*, *Navicula viridis*, and numerous fragments of the needle-shaped *Spongiæ*. Besides these animal remains, a very considerable quantity of the *fossil pollen of the Pine* was also observed, wholly similar to that which is found in Europe under the same circumstances. Six of these fossil American species, it is further mentioned, are known as living species in Europe. Four others are known in Europe as fossils, of which three have been observed only in the "*Mountain-meal*" (Bergmehl) of Sweden and Finland. Needle-shaped Spongiæ have also been found in a fossil state in Sicily. The *Amphidiscus*, which is indicated as a new genus, Prof. Ehrenberg thinks may possibly be only the inner portion of some peculiar *Spongia* or *Tethya*. In shape it is a cylinder with a disk at each end, as the name denotes, and is compared to a thread-spool, (*Zwirn-Rollchen.*) Vide *Bericht Verhandl. k. Preuss. Akademie der Wissenschaften zu Berlin* for February, 1839, p. 31. The *Amphidiscus* has not been detected in Europe; but since the date of the above notice, we learn from Prof. Ehrenberg, that he has discovered the same species among other fossil infusoria from the banks of the Amazon. We would inform the curious in such matters, that deposits of the kind are very common in the United States, in situations similar to that in which they were first noticed; and those who have suitable microscopes, may readily obtain them for examination, and will probably discover many new forms. The deposits of nearly pure siliceous infusorial remains in some parts of Germany, are twenty or thirty feet in thickness, and several miles in extent.

19. *Another work on Chemistry.*—Messrs. Barnes and Saxe of Middletown, have in press and will shortly publish, a Manual of Chemistry on the basis of Turner's Elements of Chemistry, designed as a text-book for students in colleges and other seminaries of learning, by Prof. J. Johnston of the Wesleyan University. Dr. Turner's excellent work has been held in deservedly high repute, and as a general treatise on this branch of science, for a book of the size it is considered unrivalled. Much of the work, however, and especially in the later editions, is occupied with the minutiæ of the science, which, in order to give a full view of the subject, are indeed important, but which to the student in his efforts to master its *great principles*, are rather embarrassing and perplexing. Prof. J. has therefore formed the plan of preparing a work on Chemistry designed exclusively for use as a text-book, which shall present faithfully the great features of the science, with the most recent improvements, unencumbered with other matter that cannot be made directly available in the recitation room. To do this he has adopted Dr. Turner's general arrangement, and made use of so much of his work as was adapted to his purpose, supplying the place of the remainder by other matter chosen from every source within his reach. The work will be of a medium size, but will contain as much matter as is generally made use of by college classes.

20. *Progress of the U. S. Exploring Expedition.*—The vessels of the Exploring Squadron arrived at Sydney, New South Wales, early in December, 1839. The officers and men were received with great kindness and treated with much hospitality by the authorities and the people. The Expedition sailed from Sydney on the 26th December, with the intention of proceeding as far south as circumstances would permit. It was expected that the squadron would return from its southern explorations so as to be at New Zealand about the 1st of April, whence it will proceed to the Sandwich isles previous to visiting the Columbia river. The scientific corps were left at Sydney, with orders to join the squadron at New Zealand.

The schooner Sea Gull, containing fifteen persons, officers and men, has not been heard from for more than a year. There seems to be little ground for doubt that she perished at sea during the first southern exploration of the squadron early in the year 1839, and probably left no survivor to tell her melancholy fate.

21. *Magnetic Observations.*—We are gratified to hear that the American Academy of Arts and Sciences have also resolved to co-operate in the great system of magnetical observations now going on in all parts of the globe. The Academy have appropriated $1000 for purchasing the ne-

cessary instruments. An arrangement has been made between the Academy and the Corporation of Harvard University, by which the instruments will be placed in the buildings recently erected at that University for astronomical and other observations, and a series of magnetic and meteorological observations made with them by the gentlemen who have the charge of the Cambridge Observatory, in correspondence with the instructions furnished by the Royal Society of London, and in co-operation with their own observers.

22. *Auroral belt of May* 29, 1840.—About 9h. 20m. P. M. of Friday, May 29, 1840, a luminous belt, spanning the heavens from east to west, was seen by several persons in this city. When fully formed, about 9h. 22m., its width was from 3° to 5°, being widest and most luminous on the western portion; its altitude, at the highest part, about 85° above the southern horizon. Its light was similar and equal to that of ordinary auroral streamers. The extremities of the belt were 10° or 20° above the horizon, but their position was not particularly noted, and may have varied 10° or more from the E. and W. points. The northern edge of the belt was well defined; the southern was not very distinct. The belt slowly drifted southward, at the rate of about a degree per minute. At 9h. 30m., at which time the belt was brightest and most perfect, its northern edge was projected on Arcturus. Just before the belt reached this star, there was a slight bending, concave to the north, in that part of the belt which lay not far east of the meridian. This occurred near that region of the heavens in which (at this town) an auroral corona is manifested. The belt soon began to fade, and by 9h. 45m. was nearly extinct, but for ten minutes longer, a small remnant of it was visible in the southwest, which, just before it disappeared, passed to the south of Regulus. The summit of the belt was, at vanishing, about 10° south of Arcturus. This belt was apparently constituted in part of beams obliquely transverse to its length, but this character was on this occasion less conspicuous than has commonly been noticed in other cases. During the whole time the sky was obscured by haziness and partially by clouds. There was some auroral light about the northern horizon, but it had no visible connection with the belt. Soon after 10h. this light increased exceedingly; numerous streamers rose to the altitude of 50°, and auroral waves flashed up nearly or quite to the coronal point.

This auroral belt was seen at New York city, and doubtless at many other places. If observations upon the position of the edge of the belt at given times were made at any considerable distance north or south of New Haven, we might have the means of finding approximately its height above the earth. If any such observations were made, it is to be hoped that they will be given to the public.

E. C. Herrick.

New Haven, Conn.

23. *Petroleum Oil Well.*—About ten years since, whilst boring for salt water, near Burksville, Kentucky, after penetrating through solid rock upwards of two hundred feet, a fountain of pure oil was struck, which was thrown up more than twelve feet above the surface of the earth. Although in quantity somewhat abated after the discharge of the first few minutes, during which it was supposed to emit seventy five gallons a minute, it still continued to flow for several days successively. The well being on the margin and near the mouth of a small creek emptying into Cumberland river, the oil soon found its way thither, and for a long time covered its surface. Some gentlemen below applied a torch, when the surface of the river blazed, and the flames soon climbed the most elevated cliffs, and scorched the summit of the loftiest trees. It ignites freely, and produces a flame as brilliant as gas. Its qualities were then unknown, but a quantity was barrelled, most of which soon leaked out. It is so penetrating as to be difficult to confine in a wooden vessel, and has so much gas as frequently to burst bottles when filled and tightly corked. Upon exposure to the air it assumes a greenish hue. It is extremely volatile, has a strong, pungent, and indescribable smell, and tastes much like the heart of pitch pine.

For a short time after the discovery, a small quantity of the oil would flow whilst pumping the salt water, which led to the impression that it could always be drawn by pumping. But all subsequent attempts to obtain it, except by a spontaneous flow, have entirely failed. There have been two such flows within the two last years. The last commenced on the 4th of July last, and continued about six weeks, during which time twenty barrels of oil were obtained. The oil and the salt water, with which it is invariably combined during these flows, are forced up by the gas, above two hundred feet, into the pump, and thence through the spout into a covered trough, where the water soon becomes disengaged and settles at the bottom, whilst the oil is readily skimmed from the surface. A rumbling noise resembling distant thunder, uniformly attends the flowing of the oil, whilst the gas which is then visible every day at the top of the pump, leads the passing stranger to inquire whether the well is on fire.—*N. O. Bulletin.*

24. *Fresh-water and Land Shells from the neighborhood of Chillicothe, Ohio. Presented to Yale College by A. Bourne, Esq., Civil*

Engineer.—The shells named in the following list have, with great liberality, been presented to the cabinet of Yale College, by Mr. Bourne. They embrace a full series of all the shells yet discovered in the neighborhood of Chillicothe. They are uncommonly perfect; the beaks of many species, which have always been remarked as much worn and abraded, are in the specimens of this collection quite covered with the epidermis.

There are commonly from four to twelve individuals of each species, embracing all the varieties and discrepancies which arise from age, and from still or rapid water, smooth or stony bottom, and particularly that curious structural difference of sex first pointed out in Vol. XXVI, p. 117, of this Journal, by Dr. J. P. Kirtland, and now further illustrated by the same author in the present number, p. 164. This local collection contains two orders, fourteen genera, ninety four species, and three hundred and ninety five specimens. We give the list of Mr. Bourne without alteration or annexing the authorities for the specific names he has subjoined, as follows:

Unio alatus.
" gibbosus.
" parvus.
" lapillus.
" calceolus.
" compressus.
" zigzag.
" planus.
" coccineus.
" plicatus.
" torsus.
" declivis.
" metanever.
" lævissimus.
" pyramidatus.
" cuneatus.
" undatus.
" lachrymosus.
" securis.
" abruptus.
" ellipsis.
" irroratus.
" cornutus.
" ventricosus.
" rubiginosus.
" turbuculatus.
" cylindricus.
" circulus.
" iris.
" triangularis.
" ovatus.

Unio oriens.
" occidens.
" politus.
" pustulatus.
" phaseolus.
" scalenius.
" rectus.
" perplexus.
" elegans.
" gracilis.
" multiradiatus.
" siliquoideus.
Alasmodonta rugosa.
" complanata.
" edentula.
" truncata.
Anodonta plana.
" incerta.
" Ferussaciana.
" aerolatus.
" Wardiana.
Cyclas partumia.
" dubia.
Helix paterna.
" perspectiva.
" paliata.
" clausa.
" hirsuta.
" arboreus.
" elevata.
" solitaria.

Helix profunda.
" alternata.
" fuliginosus.
" albolabris.
" thyroidea.
" multilineata.
" zaleta.
" tridentata.
" inflecta.
" concava.
" Pennsylvanica.
Melania depigis.
" Sayii.
" Virginica.
" canaliculata.
" semicarniata.
Lymnea umbrosa.
" reflexa.
" decidiosa.
Planorbis bicarinata.
" amigeris.
" trivalvis.
Physa elliptica.
" heterostropha.
" aurea.
Paludina decisa.
Pupa exigua.
" corticaria.
Succinea obliqua.
Cyclostoma lapidiana.
Ancylus rivularis.

25. *Notices of Proposals for Reforming the Orthography of the English Language.*—The imperfections of English orthography are so great and so manifest, that no one can fail to desire its amendment.

The legitimate objects of an improved English orthography are, (1.) an enumeration of all the simple sounds in the language; (2.) an appropriation of one character, and of one only, to each simple sound; (3.) the invention of an entirely new character, or else a selection of such characters now in use as would be most readily understood by all who employ the Roman alphabet; (4.) that analogies between certain sounds, as *p* and *b*, *s* and *z*, should be denoted by corresponding analogies between the characters; (5.) that a regard should be had to the ease or conciseness of writing; and (6.) that the names of the letters should be simplified and rendered uniform.

1. Mr. *A. D. Sproat*, of Chillicothe, Ohio, in a letter to the senior editor, dated Feb. 22, 1834, proposes to introduce thirty nine entirely new characters, viz. twelve for pure vowel sounds, and twenty seven for consonant sounds. The chief peculiarities of his system are, that the subtonics *b*, *z*, etc. are expressed by curving one of the lines of the corresponding atonics, *p*, *s*, etc.; that the nasal vowels are expressed by crossing the stem of the corresponding simple vowels; and that the length of the vowels is denoted by the length of the arm of the letter. These are ingenious suggestions.

2. Mr. *Michael H. Barton*, of Geneva, N. Y. (the editor of "*Something New*," Boston, 1830,) in the first number of "*The Morning Sun*," Geneva, N. Y., Feb. 25, 1839, proposes, after twenty years' attention to the subject, a plan for reforming the present English orthography.

He finds twelve pure vowel sounds, and twenty one simple consonant sounds, besides three diphthongs, and eight double consonants.

For all these he offers two distinct modes of notation; one, by means of entirely new characters, which he appears to have taken at random; the other, by availing himself of the present English alphabet, together with a few Greek characters, which he employs without any care in the selection.

In carrying out the latter mode of notation, he proposes (1.) to reject all superfluous letters; as, *da* for *day*, *dó* for *dough*, *gost*, *hole* for *whole*, *no* for *know*, *rite* for *write*, *shal*, *tru*, *woud* for *would;* (2.) to transpose certain letters; as, *center*, *gentelmen*, *trubel;* (3.) to substitute the appropriate character; as, *aty* for *eighty*, *confushun*, *hoze* for *whose*, *na* for *neigh*, *nu* for *new*, *oba* for *obey*, *obade* for *obeyed*, *ov* for *of*, *ruf* for *rough*, *savyer* for *saviour*, *wade* for *weighed;* and (4.) to use simple *u* for the pronoun *you*, and simple *b* for the verb *be*.

3. Dr. *Joseph Torrey*, of Salem, Mass., in a letter to the editors, dated Dec. 1839, dwells largely on the imperfection of our existing orthography, and on the acknowledged advantages of a more perfect system. He finds

twelve vowel sounds, and twenty five consonant sounds. He proposes to express the short sounds of the vowels by inverting the usual characters for the same, and to express the sounds for which we have no simple characters in our language, by taking the characters which are redundant.

On these various plans we remark, that in the present advanced state of the English language and literature, it is extremely undesirable to increase the existing confusion, by giving a new sound to any of the characters now in use, or to invent new characters, unless their expediency shall be almost self-evident.

26. *Flora of North America;* by Drs. Torrey and Gray. Parts III and IV. June, 1840. New York, Wiley & Putnam.—These two parts complete the first volume of the work, which extends to about 720 pages, and concludes the history of the polypetalous division of the dicotyledonous or exogenous plants. The third part comprises the remainder of the *Leguminosæ*, and the orders *Rosaceæ*, *Calycanthaceæ*, *Melastomaceæ*, *Lythraceæ*, *Rhizophoraceæ*, *Combretaceæ*, *Onagraceæ*, *Loasaceæ*, *Turneraceæ*, *Passifloraceæ*, *Cucurbitaceæ*, and *Grossulaceæ*. The fourth includes the *Cactaceæ*, *Surianaceæ*, *Crassulaceæ*, *Saxifragaceæ*, *Hamamelaceæ*, *Umbelliferæ*, *Araliaceæ*, *Cornaceæ*, *Loranthaceæ*, and a copious supplement. Several genera are introduced for the first time into the North American flora, and the following new ones are established:

Pickeringia, (*Nutt.*) founded on a Californian plant.

Nuttallia, founded on a plant from Oregon.

Peraphyllum, (*Nutt.*) from the Rocky Mountains.

Hypobrichia, (*M. O. Curtis,*) a plant of the United States.

Eulobus, (*Nutt.*) from California.

Echinocystis, a plant of the United States.

Discanthera, a Texian plant.

Solmiea, an Oregon plant.

Jamesia, from the Rocky Mountains, where it was discovered by Dr. Edwin James.

Edosmia, (*Nutt.*) from California and Oregon.

Neurophyllum, from the United States.

Euryptera, (*Nutt.*) from California.

Leptotænia, (*Nutt.*) from Oregon and California.

Eurytænia, a plant from Texas.

Glycosma, (*Nutt.*) a plant from Oregon.

Cynapium, (*Nutt.*) on some plants of Oregon.

Musenium, (*Nutt.*) on some plants of the Upper Missouri, Oregon, &c.

Apiastrum, (*Nutt.*) on some Oregon and Californian plants.

Deweya, (which is dedicated to Prof. Dewey, now of Rochester, New York,) on a Californian plant.

27. *Specimens of Minerals and Rocks.*

To the Editors of the American Journal of Science, &c.

Gentlemen,—You will recollect that in Vol. XVII of your Journal, I gave some account of the extensive establishment at Heidelberg in Germany, for the sale of specimens of minerals and rocks, having lately received a box myself. As I have within a few weeks received one thousand two hundred specimens from that institution for Amherst College, I take the liberty again to call the attention of your readers to that establishment, in the belief that specimens can be obtained there at a cheaper rate than almost any where else, and yet of the best quality, and put up in the neatest manner. By turning to Vol. XVII of your Journal, your readers will see that a great variety of collections in crystallography, precious stones, mineralogy, and geology, are put up at this institution. As I have given in that place so full an account of these collections and their prices, I shall now speak only of those which I have recently received.

1. *A geognostic collection of six hundred specimens,* presents all the important varieties of known rocks, with many of their characteristic petrifactions. The specimens are three inches by four, and trimmed in the neatest manner, with labels in German, French, and English, and arranged according to the system of Prof. Leonhard. It is so complete a collection, as to leave one little to desire in respect to the rocks of continental Europe. Price $92.

2. A smaller collection of two hundred specimens, very similar to the above. Price $22.

3. A collection in *economical geology,* or the useful rocks and minerals, three hundred specimens. Price $32. This is an admirable collection, embracing all the principal ores, several of the precious stones, (some of which are polished,) and the common rocks useful in a pecuniary point of view.

4. *A collection of precious stones.* This consists of fifty different sorts, and more than three times that number of specimens, from the diamond downwards. More than half are cut and polished. Price $28. They are very neatly put up.

I received also three slabs containing the tracks in relief of Chirotherium, from Hildburghausen, in Saxony. But it is doubtful whether this institution can furnish many more of these, as they have become very scarce and expensive.

The above collections were put up in so excellent a manner, that scarcely a single specimen was injured. It appears to me that many public institutions in our country would be glad to obtain such collections as the above. They are exactly fitted for public instruction.

Allow me to say a few words on the mode of procuring collections from Heidelberg. If any one wishes to make enquiries, let him direct a letter by mail (paying the postage to New York,) to *Lewis Wm. Zimmern, at the Mineralogical Institute, Heidelberg, Germany*, and he will receive an answer. Mr. Zimmern is connected with some of the first mercantile houses in Europe, and he requested me to allow him to draw on Hottenguer & Co., in Paris. This I was enabled to do through the kindness of the house of Prime, Ward & King, in New York; and I have reason to suppose that this firm would be willing to do the like favor to others, charging only a very moderate commission. It is necessary only to forward to that house the amount which Mr. Zimmern has liberty to draw for. I give these details because they may save others, as little conversant with pecuniary transactions as myself, several months delay, should they wish to order collections from Heidelberg.

I beg leave to say, that I have no pecuniary connection with the Heidelberg Institute, and make these statements only with a wish to have such collections as can be obtained there, multiplied in our country, and because I have abundant reason to believe, that the most perfect confidence may be placed in the gentleman who has charge of that institution. I have a few catalogues of his collection, which I should be happy to send to any gentleman why may desire them. Respectfully,

EDWARD HITCHCOCK.

Amherst College, (Mass.) June 1, 1840.

28. *Carburetted Hydrogen.**—The students at West Town boarding school, Chester Co., Penn., for want of a better place, bathe in a mill-pond of very limited extent. Chester Creek, a mere brook, enters at the northern extremity. The banks on all sides are covered with timber, from which an abundance of leaves and decayed wood find their way into the pond. Hence the great quantity of gas, that every person wading in the pond must have noted.

I first visited the place in the year 1834, and on noticing the gas, determined to collect some for the purpose of examination. Taking as apparatus a bell-glass furnished with a stop-cock, and a taper, and as companion an assistant teacher in the school, (now assistant superintendant at Harnford School,) we proceeded to the pond, readily filled the receiver, and fired the gas issuing from the stop-cock. We next proposed to burn the bubbles as they arose from the water. On stirring the leaves the gas ascended in large quantities, affording an admirably successful experiment. No sooner was the lighted taper brought near the surface of the water, than we found ourselves enveloped in flames. To retreat was of course the first impulse. Fire and water, though usually antagonist elements,

* Providence, R. I., 5th mo. 21st, 1840.

Prof. B. Silliman,—If any of the facts in the following extract from a lecture delivered about a year ago, before the Providence Franklin Society, be deemed worthy of a place in the "American Journal," &c., they are at thy disposal.

Thine respectfully, MOSES B. LOCKWOOD.

in this instance formed an alliance so friendly, that to our consternation as well as amusement, we were pursued to the very banks. We however escaped with but a slight scorching. We soon found means, however, to repeat the experiment with perfect impunity. This was done by selecting a position where the water was three or four feet deep, lying on our backs with our legs extended, and allowing no part of our persons to touch the bottom except the feet, over which the gas might be inflamed, and would continue to burn as long as the leaves were stirred beneath. In this way we could cause the flame to follow us several rods. By raising the feet at pleasure it would expire.

With this experience, we determined to repeat the experiment in the presence of the scholars. Their next visit to the pond was deferred till evening, that darkness might render the phenomenon more imposing. The boys were simply informed that "Master Moses was a going to *set the river afire*," and that their assistance would be necessary to the satisfactory performance of the experiment. The usual preparation for bathing being made, some fifty of the less timid entered the water, with the injunction to step as lightly as possible till the pond was discovered to be on fire, when all would be at liberty to proceed as would best suit their inclinations. We soon came to a favorable spot, and the gas beginning to come up pretty freely, a lighted taper was brought near the surface, when in an instant a lambent flame played upon our unprotected bodies, and cast a gloomy light upon the surrounding forest, disclosing here and there amid the thick underbrush the pale faces of their shouting companions who remained upon the bank. In the hurry the injunction to step lightly was forgotten, and the general stir of the leaves which took place extricated the gas in such abundance that the flame rose several feet above our heads. As they separated from me I raised my feet from the bottom, and found it much more difficult to suppress my laughter than to extinguish the flames.

29. *French Exploring Expedition to the Antarctic Regions.*—We are indebted to the polite attentions of J. Balestier, Esq., U. S. Consul at Singapore, for a copy of the "*Singapore Free Press*," of July 11, 1839, containing a translation of a sketch of the movements of the French Antarctic Expedition, under *D'Urville*. The sketch was prepared by Commodore D'Urville for the Society of Arts and Sciences of Batavia, and was read June 19, 1839.

The corvettes *L'Astrolabe* and *La Zelée* sailed from Toulon, Sept. 7, 1837, on the expedition above mentioned. They arrived at the *Straits of Magellan*, Dec. 12, where they remained twenty-eight days employed in surveying, and in ethnographical investigations, and in making collections in natural history, and observations in natural philosophy. Afterwards they explored the entire eastern coast of Terra del Fuego, and the northern coast of Staten Island, and then about the end of December, sailed for the southern polar regions. They were, however, unfortunately prevented by barriers of ice from proceeding as far south as had been done by many preceding navigators. Disappointed here, they occupied the rest of their stay in that region in exploring the New South Orkney isles, some of the New South Shetland isles, and also for about eighty leagues, a territory of great extent, which they named *Terres de Louis Philippe.* They then proceeded to Talcahuano, in Chili, for the restoration of the health of the crew. This place they left May 22, and passed three days at Valparaiso, and about the beginning of August dropped anchor at the Mangariva (Gambier) islands. They cursorily surveyed the isles Minerva and Serles, and passed some days in the isle of Nouhiva. The natives are a fine race of Polynesians, handsome, tall, well made, agile, and robust. On the 9th Sept. they arrived at Tahiti; they surveyed all the isles of the Tahitian archipelago, then the isles Mopelia and Scilli, and carefully took the bearings of the coasts of the isles which compose the archipelago of Samoa. A short stay in the island of Opoulon, added to their collections in every department. They next visited the isles of Vavao and Hapai, and afterwards the isle of Ovalaou. Subsequently they explored the islands of Arviare and Pic de l'Etoile, and also the Banks group, which had never been seen since its discovery by Bligh,—likewise the isles of Vanikoro, (celebrated for the shipwreck of *La Perouse*,) Lopona, Nitendi, Mendana, and the volcano of Tinakoro; and about the middle of November, they reached the Solomon islands. This extensive archipelago was the object of a special survey. They laid down with care the bearings of two hundred leagues of its coasts, and resolved the doubts which have divided the opinions of the most distinguished hydrographers, regarding the number and the relative situation of the isles of which it is constituted. They remained several days in the neighborhood of the large isle Isabella, the natives of which are of the small Melanesian race, feeble, averse to labor, and cannibals; but who still sometimes showed themselves mild and peaceable, and rather honest. Among the Caroline islands, they surveyed the Nougour and Louassap groups, and came to anchor over against the great Rook cluster. The natives of the latter appeared to be suspicious and hypocritical. The year 1839 they entered upon while at Umata, isle of Guam, where they refreshed themselves with some relaxation. On the 10th Jan. they set sail, and surveyed the Pelew, Gouap, and Palmas isles, and laid down forty leagues of the southern coast of Mindanao. They fixed with care the position of the isles lying between Mindanao and Celebes. By the end of January they resumed their surveys on the southern coast of Ceram, and the coast of New Guinea. The westerly monsoon now drawing to a close, they proceeded to Raffles Bay, in Australia, where the English for some time had a settlement; they also visited the colony at Port Essington, which had just been founded under the superintendence of Captain Bremer. They surveyed the whole extent of the western coast of the Arron isles; spent three days at the anchorage of Aobo, and visited the fort which the Dutch once owned in the isle of Wokam, but which is now a heap of ruins. They also halted five days at the head of Triton Bay, where the Dutch have lately established a small settlement. The coast of New Guinea was carefully examined from this point to the southern extremity of Maclure's passage. Retracing their steps, they employed three days in the anchorage of Warou, in Ceram. In May, they took the bearings of the northern coasts of Ceram and Bouron, the most southerly part of Bouton, as also of Celebes, then the Straits of Salayer, as far as Macassar. They then bore straight away for Borneo, where they examined the coast at Salatan point, and finally made sail for Batavia, where they arrived on the 8th of June, 1839. It was expected that the expedition would reach home in twelve or fifteen months from that date.

30. *Proceedings of the Microscopical Society of London.* (A. G.)—The Microscopical Society of London held their first meeting on Wednesday, Jan. 29th, at the Horticultural Society's rooms, No. 21, Regent Street. The meeting was attended by upwards of a hundred members and visitors.

The President, Prof. Owen, announced that since the provisional meeting on the 20th of December last, for the purpose of forming the Society, the number of members had increased to one hundred and ten, and a farther addition of twenty-nine names was announced in the course of the evening, making a total of one hundred and thirty-nine original members, it having been determined that those who joined the Society on or before the first night of meeting should be considered original members.

Mr. Owen communicated a paper on the application of microscopic examinations of the structure of teeth to the determination of fossil remains. After alluding to the essential service rendered to the chemist, mineralogist, and vegetable physiologist, he proceeded to offer a few examples of the utility of the microscope to the investigation of the structure of fossilized teeth.

The first example adduced was that of the *Saurocephalus*, an American fossil animal, which had been referred to the class of reptiles. After pointing out the distinctive characters of the microscopic texture of the teeth in reptiles and fishes, it was shewn that the Saurocephalus, according to this test, unquestionably belonged to the latter class, and that it most closely resembled *Sphyræna* among recent fishes in its dental structure.

The second instance was the *Basilosaurus* of Dr. Harlan, which has been referred to the class Reptilia; and the double-fanged structure of its teeth had, on the strength of its supposed saurian affinities, been adduced to weaken the arguments advanced in favor of the mammiferous nature of certain fossils from the Stonesfield oolite. Mr. Owen, after describing the microscopic character of the teeth of the Basilosaurus, shewed that it deviated from the saurian structure in this respect as widely as the Saurocephalus, but that the modifications of its dental structure resembled most closely that of the Cachalot and herbivorous Cetacea. Lastly, Mr. Owen alluded to the difference in the views entertained by Cuvier and M. de Blainville, as to the affinities of the *Megatherium*, which was referred by the one to the family of the sloths, and by the other to that of the armadillos; after explaining the well marked differences in the microscopic characters of the dental structure in these two families of the so-called *Edentata*, Mr. Owen proceeded to describe the structure of the teeth of the Megatherium, and to shew that in its close resemblance to the dental structure of the sloths, it confirmed the views of the great founder of the science of fossil remains. This paper was accompanied by a number of very beautiful illustrative drawings, exhibiting the minute structure of the teeth of the animals referred to.

Mr. Jackson then read a short paper, drawing the attention of the Society to a mode of mounting the compound microscope, which differs in some particulars from the methods generally adopted. The principal object to be kept in view in the construction of the instrument, is the prevention of those accidental vibrations which so much interfere with microscopic examinations, especially in the neighborhood of crowded thoroughfares. This object is effected by connecting together the body and the stage of the instrument in such a manner, that whatever vibrations are communicated to the one shall be equally communicated to the other. In the instrument of Mr. Jackson, this principle has been carried further than has hitherto been effected; and it also affords improved facilities for minute adjustments, and the accurate admeasurement of microscopic objects.

A discussion ensued on the subject of Mr. Jackson's paper, and also on the best modes of measuring microscopic objects, and the greater difficulties encountered in ascertaining the antero-posterior diameters of minute bodies, as compared with the facilities which we possess of obtaining lateral measurements. The meeting then resolved itself into a conversazione, during which a number of interesting objects were exhibited by individual members, many of whom had their microscopes upon the table. The meeting adjourned at 11 o'clock.

Wednesday, Feb. 19.—R. H. Solly, Esq. in the chair. A paper was read by Mr. Queckett, on the development of the vascular tissue of plants, in which it was shown that the membranous tube of vessels originated from a *cytoblast* in a manner similar to that described by Schleiden in the formation of cells, from which it is at first difficult to recognize them; but in a short time, they assume a very elongated form, and the cytoblast disappears. Before the fibre is deposited, the contents, which are gelatinous, are crowded with numerous most minute granules, which possess the motion known as that of "active molecules," and after a short time, when they have become a little enlarged, they adhere to the inner surface of the tube containing them in a different manner for each vessel; so that the several varieties of vascular tissue are not degenerations of each other, but are constructed originally on the plan they are always observed to present to the eye.

It had been conjectured by Schleiden that a current existed between the gelatinous contents of the cell and its walls, which preceded the formation of a fibre, and gave the direction it afterwards took; this was refuted by showing that the granules became separately attached to the inside of the vessel, at a little distance from each other, beginning first at one end and proceeding to the opposite, the fibre elongating like a root, by the materials of growth being always added to the point. The granules so attached, becoming nourished by the contents of the vessel, and the spaces between them are in a short time obliterated by the fibre occupying a defined border, which completes its development. [The varied manner in which the granules are deposited, so as to produce all the varieties of vascular tissue, is explained in the remaining portion of the abstract of Mr. Queckett's paper.]—*From the Annals of Natural History for March*, 1840.

31. *On the remarkable diffusion of Coralline Animalcules from the use of Chalk in the arts of life, as observed by Ehrenberg.*—An examination of the finest powdered sorts of chalk which are used in trade, has afforded Prof. Ehrenberg the following result: that even in this finest condition, not merely the inorganic part of the chalk is become separated, but that it remains mixed with a great number of well-preserved forms of the minute shells of coral animalcules. As powdered chalk is used for paper hangings, Prof. Ehrenberg also examined these, as well as the walls of his chamber which were simply washed with lime, and even a kind of glazed vellum paper called visiting cards, and obtained the very visible result—demonstrating the minuteness of division of independent organic life; that those walls and paper-hangings, and so, doubtless, all similar walls of rooms, houses, and churches, and even glazed visiting cards prepared in the above mentioned manner, (of which cards, however, many are made

with pure white lead without any addition of chalk,) present, when magnified three hundred diameters, and penetrated with Canada balsam, a delicate mosaic of elegant coralline animalcules, invisible to the naked eye, but, if sufficiently magnified, more beautiful than any painting that covers them.—*Annals of Natural History, p.* 286, *No.* 24, *for December*, 1839.

32. *Analysis of the Upas, (Juice of Antiaris toxicaria,) by Mulder.*—A portion of the juice of the Upas tree, brought from Java, by *M. Blume*, yielded, on analysis by *Prof. Mulder*, the following results:

Vegetable albumen, - - - - -	16.14
Gum, - - - - - - -	12.34
Resin, - - - - - - -	20.93
Myricin, - - - - - - -	7.02
Antiarin, - - - - - - -	3.56
Sugar, - - - - - - -	6.31
Extractive matter, - - - - -	33.70
	100.00

Antiarin, the only active substance of this juice, is one of the most deadly poisons known. Its effects, when greatly diluted, are vomiting, diarrhœa, convulsions, and the like. It is a peculiar neutral, almost uncombinable substance, retaining its properties when mingled with water, &c.—*Bull. Sci. Phys. & Nat. Neerlande*, 1838.

33. *Advantages of iron compared with wood Steamers.*

1. The first cost of an iron vessel is from fifteen to twenty per cent. less than a wood vessel.

2. The capacity of an iron vessel is much greater than that of a wood vessel of the same dimensions, in consequence of the less space occupied by the material; an iron vessel of four hundred and thirty tons would present about the same internal surface as a vessel of five hundred tons, built of wood.

3. The weight of an iron vessel is not more than two-thirds of that of a wood vessel of corresponding tonnage; hence the displacement of the iron vessel is much less; therefore the diminished power of her engines and comparative quantity of fuel required, makes the combined displacement very much in favor of the iron steamer.

4. An iron steamer is of much greater durability, without the repairs rendered necessary by the common wear and tear of wood steamers. It was stated before the House of Commons, that an iron vessel had been worked for thirty-six years, and that an iron steamer had been constantly employed for sixteen years, and at the expiration of that

time her bottom was examined and found free from oxidation, the outer scales and rust had disappeared, leaving the bottom perfectly smooth and clean. Now a wood vessel during that time would have required her copper to have been four times renewed, as often recalked, paid and painted, besides frequent and small repairs in replacing defective wood, and at the expiration of that time either condemned or thoroughly repaired, and if we add the value of the time required to effect such repairs, the economy of using iron steamers will be found enormous.

5. Perfect safety from fire is another of the great advantages to be realized by adopting iron steamers. The returns of steam vessels lost in one way or another, demonstrate that *a great proportion of these losses have arisen from fire.* It naturally follows that the premium of insurance would be much less for iron vessels than wood. The present custom is the use of wood beams and deck, but were it necessary for still further security, iron might be substituted with equal ease for both.

6. The danger of the vessel's sinking by springing a leak, if not entirely obviated, is very much lessened. The facility of dividing an iron vessel's hold into departments by iron bulk-heads, which can be made as tight and as strong as a boiler, is very obvious; therefore if a leak takes place in any one division, that division may be filled as high as the outer surface of the water, and the vessel be still comparatively secure. Moreover, a leak at sea on board an iron vessel, may be much more easily discovered than it could possibly be on board wood vessels, as it would not be hidden by a mass of timber. Another advantage would be perfect freedom from the smell of the engine room, which could not reach the cabins, and an entire absence of bilge water, so offensive on board all wood vessels. The plan of dividing the hold of wood vessels by means of partitions, will doubtless answer some good purpose, but where so intense a heat exists as in the interior of a steamer, the wood must and will draw; this, added to the working of a wood vessel, would render it absolutely impossible to make the bulk-heads tight.

7. The danger from lightning is very much diminished, as the whole body of the vessel is a conductor of electricity. Lander's voyage to Africa in an iron steamer corroborates this fact, and I find the opinions of the most scientific men concur on this subject. The captain of a steam vessel, who commanded a steamer on the Mississippi more than twenty years, told me that he never knew a steamer to be struck with lightning when her engine was at work.

8. In tropical climates there is a great advantage in iron steamers, as the internal temperature of the hold would be very much cooled

by the surrounding water, which would greatly add to the health and comfort of those on board. This result was also experienced on board the iron steamer already referred to, which went to Africa. Another advantage, which will be fully appreciated by those accustomed to voyages in tropical climates, is the entire freedom from insects and other animals which overrun wood vessels, forming in frequent instances, a perfect barrier to all comfort.

9. Iron steamers are less exposed to accidents than wood steamers; if the latter for instance touches the ground but slightly and only to rub her copper, which is often the case, it is absolutely indispensable in tropical climates, to have it immediately replaced, or otherwise a few weeks will be sufficient for the worms to destroy that part of the bottom so exposed. The expense attendant even on such slight repairs, particularly in the absence of docks, would be immense. In an iron vessel, under the same circumstances, no difficulty would arise. Again, an iron vessel in striking a rock, would very likely suffer an indentation in her bottom, but it would not pass through the iron, when a wood plank, under similar circumstances, would, in all probability, be broken and rent. An iron vessel has been thrown on a ledge of rocks, and after beating on it for some time, was saved; it was found that the bottom was greatly bruised and indented, but still perfectly tight, and it was admitted by the spectators that a common wood vessel, under similar circumstances, would certainly have bilged and gone to pieces. The iron bottom presents a perfectly smooth surface, the heads of the rivets forming a plane with the plates.

10. It is, I believe, an understood principle, that superior buoyancy makes a superior sea boat, and its application is strong proof in favor of iron vessels for steam purposes. We have the united testimony of many persons who have witnessed the operation of iron steamers in heavy weather, as to their great safety and security. It has been argued by some that this very buoyancy rendered them unfit for high sea use. This argument naturally carries one back to about twenty five years ince, when it was considered indispensable, that a vessel of three hundred tons should draw seventeen or eighteen feet of water, to enable her to hold a good wind and make her safe in a sea way. At present the American packet ships of seven to eight hundred tons, seldom draw, when in their best trim, more than thirteen feet of water.

11. It has been urged against iron steamers, that they are subject to extensive vibration by the action of the machinery. I was recently on board the Rainbow, (an iron steamer of one hundred and ninety-eight feet length, twenty-five feet beam, and nearly of six hundred tons,) on an experimental trip from Blackwall to Gravesend and back.

We had the full benefit of the tide down, and accomplished the distance in seventy-one and a half minutes, and allowing for a tide of three and a half miles per hour, we made fifteen and a half miles per hour through the water, working at a pressure of less than four pounds, with two ninety horse engines. The very slight vibration was a subject of general remark.

12. Another argument against iron steamers, is the difficulty of making them stiff. It seems very absurd to say that an iron form cannot be rendered equally stiff and firm as one of wood. An iron steamer is less likely to bend or hog than a wood steamer. The pressure is on the edge downwards, and it would be scarcely possible to produce such an effect, unless the iron be broken, for the rivetted part may be considered equally strong as, or even stronger than the plate.

13. The construction of iron vessels can be rendered perfect only by practice, time, and experience. The drafts or models which I have seen, admit of many improvements, but as to their eventual general adoption I have no question. To many it appears such an innovation upon custom so long established, that it is condemned without cause or reason. I am perfectly persuaded that iron steam vessels can be navigated for one half the expense incurred at present in wood vessels. The opinions of the most practical and scientific men in the kingdom are universally in favor of iron as a substitute for wood in the building of steamers, both on account of its greater security, and durability, and also of its extraordinary economy.

Since the foregoing was written, I have received a report from the Seine respecting the iron steamer Aaron Mont—that she was in capital condition, very fast, and performed her voyages to the satisfaction of the proprietors; she was built in the year 1817, has run twenty-one years, and no signs of corrosion.*—*Boston Daily Advertiser and Patriot.*

London, 18th Oct., 1839.

34. *Medical and Physiological Commentaries,* by Martyn Paine, M. D., A. M., in two vols. 8vo., pp. 716 and 815. New York, Collins, Keese & Co. London, John Churchill, 1840.

We have received from its author a copy of this extended work just at the close of our number, and too late for any thing but a passing notice. Its contents are, I. Vital powers, in three sections and an appendix; the subject is treated at more than usual length. II. Philosophy of the operation of loss of blood, in fifteen sections, with two appendixes. III.

* Drawn up by Wm. Wheelwright, Esq., now engaged in introducing steam navigation from England to Chili, across the isthmus by rail road.

The humoral pathology, in fourteen sections, with three appendixes; one on scurvy and diabetes, the second on *endosmose* and *exosmose*. From a cursory glance at the author's remarks on these subjects, we perceive he is inclined to set aside all application of the evidence which their phenomena have been supposed to bring to bear on physiological and chemical science, and to view the subject as "a part of the great system of materialism, by which many eminent physiologists, as we shall ultimately see, are endeavoring to consign to chance the origin of matter itself." (Vol. I, page 682.) The third appendix is divided into four heads, 1. Fasting in relation to humoralism. Next "on the microscope;" the value which the author sets upon this instrument as a means of advancing our knowledge may be best inferred from his own language. "The microscope having been extensively employed in the interpretation of vital phenomena, and now threatening more than ever the subversion of physiological science," &c. (p. 699.) The author then proceeds by quoting various opinions, and by ridicule, to throw the whole subject of microscopical observation out of the scale of scientific evidence, and to call in question all the discoveries of Ehrenberg in relation to the animal origin of the infusorial earth, and the occurrence of animalcules in flint and opal; and instances the authority of Prof. Hitchcock as to the similar origin of certain iron ochres from Massachusetts, as proof that "we are beginning to try our hand at it in America, having got rid of animal magnetism. We believe, however, our able Prof. Hitchcock is alone in this glory in the western hemisphere." (p. 707.) The present advanced state of our knowledge on this subject calls for no comment from us on the inappropriateness (to say the least) of such a mode of treating it.*

The third part of this appendix is a supplement to the essay on the vital powers. The fourth to that on the humoral pathology. This closes the first volume.

The contents of the second volume are,

I. Philosophy of animal heat.

II. Philosophy of digestion, and appendix on spontaneous generation.

III. Theories of inflammation, and appendix on state of circulation in fever.

IV. Philosophy of venous congestion, in sixteen sections, with six appendixes on

1. The demonstration of the disease.
2. The importance of analogy and principles in medicine.
3. On cold as a cause of venous congestion.
4. Pathology of erysipelas.
5. " " tubercle and scrofula.

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* See Prof. Bailey on the infusorial animals found by him at West Point, Vol. xxxv, p. 118, of this Journal.

6. On melanosis, animal pigments, and the philosophy of adventitious growth.

V. Comparative merits of the Hippocratic and Anatomical schools.

VI. On the principal writings of P. Ch. A. Louis, M. D. With this essay the work closes.

The typography of the work is very well executed, and does credit to the publishers; but it is inexcusable to publish any elaborate work without an index.

35. *Applications of the Science of Mechanics to Practical purposes;* by Prof. James Renwick, LL. D., of Columbia College. New York, Harper & Brothers, 1840. 12mo. pp. 327.

The distinguished author of this little volume states in the preface that in it he has endeavored to exhibit, in as popular, and at the same time as condensed a form as possible, the principles and leading facts of the application of the theory of mechanics to useful purposes." A work of this description from Prof. Renwick is worthy the attention of every practical man.

36. *Entomological Cabinet.*—Dr. C. G. Page wishes to dispose of his entomological cabinet, comprising about two thousand species and nearly a thousand duplicates. Two thirds are natives, and with the exception of about one hundred, were obtained from the vicinity of Boston, Massachusetts. The remainder is a choice selection from Maranham, Java, Japan, and China. The cabinet is in excellent order, and the characteristic distinctions of the Lepidoptera particularly are uncommonly well preserved, as most of them were raised from the eggs, in a cocoonery, purposely for the cabinet. (The specimens are mostly classified and named.) This collection is offered for four hundred dollars. Apply to Dr. Charles G. Page, Washington, D. C.

37. *Hog Wallow Prairies.**—Extract of a letter to the Editors from Prof. J. L. Riddell, dated New Orleans, May 23, 1840.—While in Texas the second time I had full opportunity to study the phenomenon of "*hog-wallow* prairies." The long droughts in summer cause the woodless surface of the prairies to crack deeply, and oftentimes symmetrically; subsequent rains wash the adjacent earth into these cracks, filling them up, converting them into little valleys, and leaving intermediate hillocks. Next year the same round of cause and effects occurs in the same places, and thus successive years contribute for a long time to produce a maxi-

* As I make mention of this appearance in my notes on the Trinity country, published in your Journal last summer, without assigning a cause, I will ask you to publish the explanation here given.—J. L. R.

mum effect, the appearance of which is very striking. When the prairie is level, the hillocks are exactly hexagonal, and usually eight or ten feet in diameter. The depressions between them are commonly twelve or eighteen inches deep. If the surface is inclined, the hexagons become elongated at right angles to the direction of the dip, when they frequently resemble the waves of the ocean. From difference of surface, soil, and exposure, there arises a great diversity in the size, depth, and general appearance of the *hog-wallows.* They never occur in a sandy soil, consequently they are not seen on the sandy prairies near the sea coast. I do not remember to have seen them among the mountains in the Camanche country; but else they frequently greet the eye of the traveller in most every part of Texas.

38. *Obituary.—Death of* Wm. Maclure.—At a meeting of the Academy, held this evening, it was unanimously

Resolved, That the Academy has learned with deep concern, the decease, at San Angel, near the city of Mexico, of their venerable and respected President and benefactor, William Maclure, Esq.

Resolved, That although his declining health induced him to reside for some years in a distant and more genial clime, this Academy cherishes for Mr. Maclure the kindest personal recollections, and a grateful sense of his contributions to the cause of science.

Resolved, That as the pioneer of American Geology, the whole country owes to Mr. Maclure a debt of gratitude, and in his death will acknowledge the loss of one of the most efficient friends of science and the arts.

Resolved, That as the patron of men of science, even more than for his personal researches, Mr. Maclure deserves the lasting regard of mankind.

Resolved, That a member of the Academy be appointed to prepare and deliver a discourse commemorative of its lamented President.

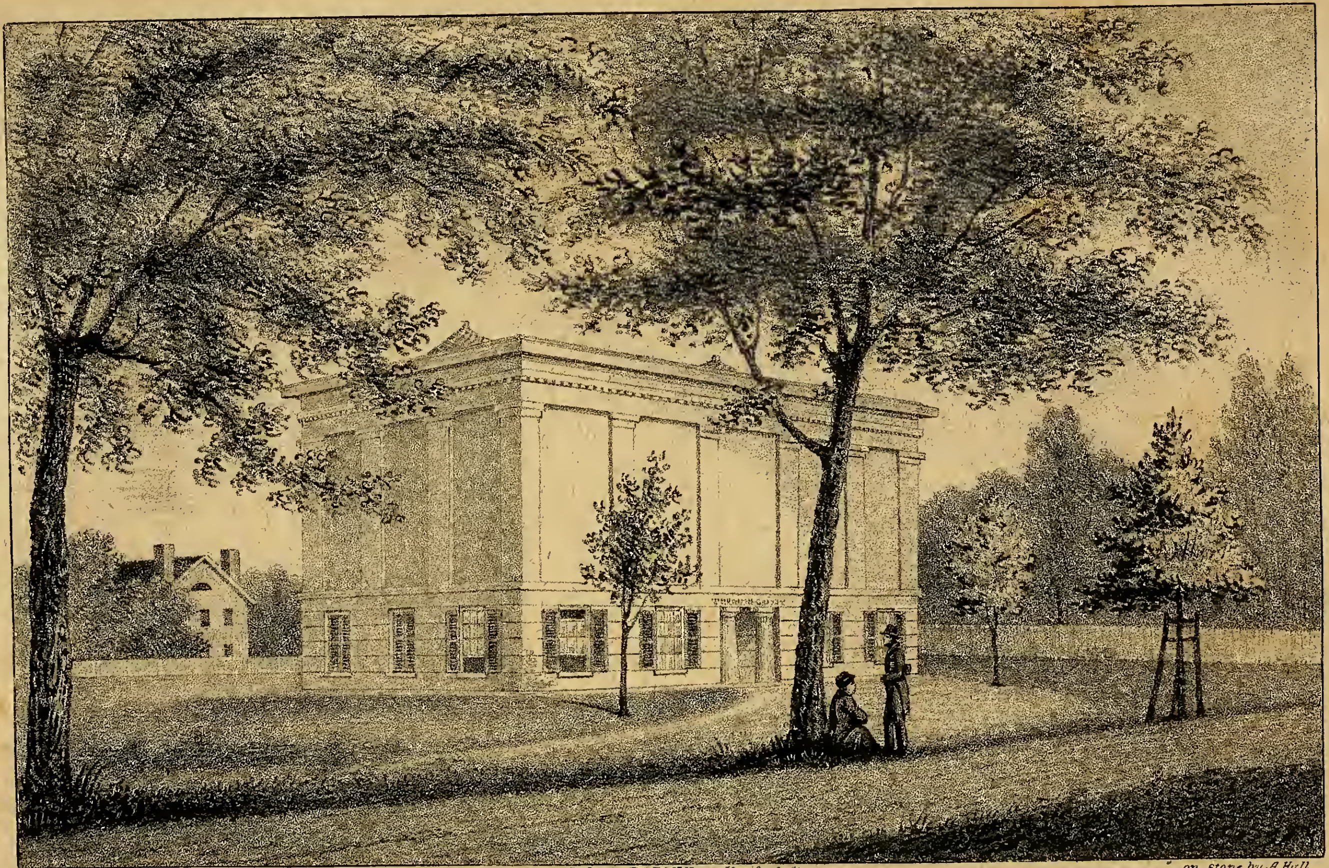
Resolved, That the Corresponding Secretary be requested to communicate to Mr. Maclure's family a copy of these resolutions.

Samuel George Morton, Corresponding Sec'y.

Hall of the Academy of Natural Sciences of Philadelphia, April 28, 1840.

Agreeably to announcement, the Academy held an election for officers on the 26th of May, when William Hembel, Esq., of Philadelphia, was unanimously elected President of the Society, to fill the vacancy occasioned by the death of William Maclure, Esq.

On the same occasion, Samuel George Morton, M. D., was elected one of the Vice Presidents of the Academy, and Robert Bridges, M. D., Corresponding Secretary.



R. Bakewell Del. Lith. of E.B. & E.C. Kellogg Hartford, Ct. on stone by A. Hull

TRUMBULL GALLERY, YALE COLLEGE.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Account of the Trumbull Gallery of Paintings in Yale College, City of New Haven.*

In the Prospectus of this Journal—painting and the other fine arts are named as being within its plan. It was in accordance with this view, that Col. Trumbull's Historical Pictures of the American Revolution were mentioned in Vol. i, p. 200, again in Vol. viii, p. 168, and lastly an account is given by Col. Trumbull himself in Vol. xvi, p. 163, of the permanent location of the pictures in the Rotunda of the Capitol at Washington. The studies of all the historical pictures, with many other original paintings of the same artist, were deposited by him in Yale College in 1832, to become, after his decease, the property of the Institution, upon the condition that the proceeds of their exhibition shall be devoted, forever, to the support of indigent students in Yale College.

A commodious stone building (a view of which forms the frontispiece of the present number) was erected in 1831, for the reception of the paintings. The basement is appropriated to offices and other purposes, and the space above is divided into two apartments, each thirty feet square and twenty four feet high, lighted from the sky. One of these rooms, that which is first entered, is devoted to miscellaneous collections, of pictures, statuary, antiquities, &c.; the second room is the Trumbull Gallery; all the pictures which it contains are the productions of the pencil of Col. Trumbull, excepting only, his own portrait by Waldo & Jewett.

The father of American Historical Painting still survives, in the vigor of his faculties; at the age of eighty four, his eye has not become dim, nor has the force of his mind, the vividness of his imagination, or the delicacy of his touch abated.

Of this any observer will be convinced, who sees the six paintings now in the gallery, which have been done within the last five or six years, and two of the most difficult during the last season.

A few years ago he commenced copying his historical paintings upon canvass of the size of nine feet by six; the great pictures at Washington being eighteen by twelve, while the original studies are twenty inches by thirty.

Of the copies of the intermediate size, nine feet by six, five have been some years finished, and preparations are made for finishing the other three, provided any state, city, university, or other institution shall manifest a wish to possess a series of pictures, which, in relation to the history of this country and to the art of painting among us, must ever remain without a rival.

Col. Trumbull still retains a large number of copies of the prints of the Declaration of Independence; of the Death of General Montgomery in the attack on Quebec, December, 1775; of the Battle of Bunker's Hill, June 17, 1775; and of the sortie of Gibraltar, November 27, 1781, which terminated one of the most memorable of sieges, and was in truth an event of the American Revolution, although its scene was in Europe.

Col. Trumbull is the sole survivor of Gen. Washington's private military family—of those gentlemen who, sharing his full confidence, were about his person in the tent and in the battle field.

In relation to his historical pictures he enjoys the rare advantage of a personal acquaintance with the individuals whose portraits he has preserved and of having participated in their dangers and sufferings.

The Trumbull Gallery has a claim to a place in this Journal because it contains the earliest, and hitherto the best historical paintings which this country* has produced. In addition to these, there are hung in the same room so many other pictures of high interest, that the whole collection presents a splendid triumph of the art, at an early day, and exhibits a magnificent and imposing spectacle.

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* Mr. West, although an American and the master and instructor of Trumbull, confined his labors chiefly to England.

The gallery has just been passed in careful revision by the artist, and a full descriptive catalogue has received the last touches of his hand. In giving an account of the gallery, we shall therefore adopt the language of the artist himself and copy his catalogue, as we did that of Dr. Mantell on a very different subject, (see vol. XXIII, p. 162,) for we ought not to condense the facts, and we cannot improve the style.

The life of Col. Trumbull, having covered more than four fifths of a century, of the most eventful import, and he having been himself, either an actor in, or a witness of many of its most thrilling events, we are happy to announce that he is just finishing a memoir of his own life, and of course, to a great extent of his own times, which will fully display, not only the history of the gallery, but of many of the events to which its pictures are devoted. Having been favored to become acquainted with the work in manuscript, we are gratified to say, that the pen of the author is not inferior to the pencil of the artist, and that the productions of both speak alike to the mind and the heart.

Col. Trumbull's writings are remarkable for perspicuity, condensation, and elegant simplicity. His pictures, we presume not to criticise—artists will form and express, as they have already done, their own opinions; but we hazard nothing in predicting, that the Trumbull Gallery, and especially its historical pictures, will be appreciated, in a higher and higher degree, with the progress of time.

As long as patriotism and taste shall survive, this Gallery will be visited, more and more; and when, beneath its massy walls and glowing canvass, the artist himself shall find his last repose—his tomb, decorated with more than the beauty of sepulchral flowers, will show vivid tints of unfading imagery, proof alike against the summer's drought or winter's cold.*

The Gallery will become a shrine, and its relics of the gone-by years will be held sacred, even amidst the din of war and the strife of civil commotion.

Nor, while indigent merit, without restriction to sect, party, or destination, shall claim the boon which the artist has bequeathed forever, to youth, nobly struggling for education—will this holy

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* His tomb, tenanted already by the remains of his nearest friend, is beneath the Gallery which will, one day, be his mausoleum—*monumentum ære perennius.*

designation be forgotten; and if the spirits of the departed are permitted to hover around our busy walks of life, or to flit, unseen, into our most sacred retirements, may we not presume that those who have left rich blessings to mankind, will be among the number of our celestial visitants.

CATALOGUE OF PAINTINGS, BY COLONEL TRUMBULL; INCLUDING EIGHT SUBJECTS OF THE AMERICAN REVOLUTION, WITH NEAR TWO HUNDRED AND FIFTY PORTRAITS OF PERSONS DISTINGUISHED IN THAT IMPORTANT PERIOD. PAINTED BY HIM FROM THE LIFE.

INTRODUCTION.

In submitting to the view of the public the Series of Paintings, commemorating important events of the American Revolution, the consideration, than an entire generation of men have passed away since the enterprise was commenced, and that very few are now living who were actors in the scenes represented, renders it proper to give some historical account of their origin, in order to establish their claim to authenticity in the view of posterity.

The artist, by whom they have been painted, was one of the aids-du-camp of General Washington, in the first year of the Revolution, (1775,) and in the succeeding year, (1776,) was the deputy-adjutant-general of the Northern Department, under the command of Major-General Gates. He retired from the service in the spring of 1777.

Ardently anticipating the vast consequences of the Revolution, and the future greatness of his country; and having a natural taste for drawing, in which he had already made some progress, (see No. 27,) Colonel Trumbull resolved to cultivate that talent, with the hope of binding his name to the great events of the time, by becoming the graphic historiographer of them, and of his early comrades.

With this view, he devoted himself to the study of the art of painting, first in America, and afterwards in Europe; and in the year 1786, he produced in London, his first considerable historical work, the Death of General Warren at the Battle of Bunker's Hill. (No. 3 of this collection.)

John Adams, afterwards President of the United States, was at that time their minister in London; and Thomas Jefferson held the same high rank in Paris. The artist was well known by both these distinguished men, and this his first patriotic work of art, was seen and appreciated by both. He explained to them his intention of painting a series of pictures, in commemoration of the principal events of the Revolution, in which should be preserved, as far as possible, faithful portraits of those who had been conspicuous actors in the various scenes, whether civil or military, as well as accurate details of the dress, manners, arms, &c. of the times; with all which he had been familiarly acquainted. Mr. Adams and Mr. Jefferson encouraged him in the prosecution of this plan, and with their approbation the following subjects were selected:

The Death of General Warren, at Bunker's Hill.
The Death of General Montgomery, at Quebec.
The Declaration of Independence.
The Capture of the Hessians, at Trenton.
The Death of General Mercer, at Princeton.
The Surrender of General Burgoyne, at Saratoga.
The Treaty with France.
The Battle of Eutaw Springs.
The Surrender of Lord Cornwallis, at Yorktown.
The Treaty of Peace.
The Evacuation of New York.
The Resignation of General Washington.

It was intended to publish a series of engravings from these pictures, and therefore a small size was adopted, suited to the use of the engraver.

Several of the compositions were immediately studied and prepared for the future introduction of the intended portraits, particularly the Declaration of Independence; so that, before the two great men, before named, returned to the United States, from their respective embassies, their portraits were painted in the work now submitted to view, (No. 9,)—the one in London, the other in Paris. The portraits of the French officers in the picture of the Surrender of Lord Cornwallis, (No. 29,) were also painted from life, in Paris, in the house of Mr. Jefferson in the year 1787.

After the present Constitution of the United States had been adopted, the artist, in the autumn of 1789, returned to America, to pursue his work. He found Congress assembled in New York, then the seat of government; and, having procured the portraits of General Washington, and of many other distinguished characters, in the several compositions for which they were intended, he afterwards travelled through various parts of the country from New Hampshire to South Carolina, in search of others; and in 1794, had nearly completed the collection of portraits, views of places, and all the various materials necessary to the execution of his entire plan.

During this period the work attracted much attention, and was generally approved. All saw the correctness of the portraits; many knew the accuracy of the circumstances recorded: and it was proposed to employ the artist to execute the entire series for the nation. This proposal failed to be carried into effect; not through any opposition from any quarter to the propriety and fitness of the object, but because the nation then possessed no building proper to receive and preserve such works; and because doubts existed then, as they have since, in the minds of some gentlemen, whether Congress possessed the right of appropriating the public money to such purposes.

In the mean time the French Revolution had commenced, and its subsequent convulsions diverted the attention of all mankind, during many years, from the Fine Arts, and from all the works and thoughts of peace; and the further prosecution of this object was suspended, until the government of the United States, in the year 1816, were pleased to pass a resolution, authorizing the artist to execute four of the subjects for the nation;—just thirty years after he had painted the battle of Bunker's Hill.

The attention of the artist was exclusively devoted to the execution of this honorable commission, until it was completed, when he resumed the small set of these then unfinished studies; and although the lapse of near forty years might have been expected to have impaired his sight in a degree which would have prevented the possibility of finishing such small works, yet, by the blessing of God, he has acomplished his original purpose to the extent, and with the degree of success which is now submitted to public examination.

CATALOGUE, &C.

No. 1.—THE DUKE OF WELLINGTON. Painted from a bust; it is recognized as a good likeness by English gentlemen and others acquainted with the features of the Duke.

No. 2.—Five Heads. Oil Miniatures.

Henry Lawrence, President of Congress, 1791.
John Jay, Chief Justice of the United States, 1792.
John Adams, Vice President of the United States, 1792.
George Hammond, Minister from Great Britain, 1792.
Temple Franklin, grandson of Dr. Benjamin Franklin, 1792.

No. 3.—The Battle of Bunker's Hill.—*June* 17, 1775.

The Revolution which effected the separation of the British Colonies in North America from the parent state, and laid the foundation of the present United States, forms, and will forever remain, the most interesting period of human history. There have been many wars, in ancient as well as modern times, marked by more extensive devastation and ruin, but these have generally resulted in the establishment of some new variety of despotism, or some mere change of dynasty; while this Revolution has not only produced the establishment of a new and mighty empire, but an empire founded on a new principle,—the principle that man, under the guidance of the representative system, is capable of governing himself, without the aid of autocracy, oligarchy, or aristocracy. The experiment is sublime,—has hitherto proved successful; and may Providence secure its lasting success, so that its influence, which is already extensively felt by many nations, may permanently affect the happiness of the human race.

Among the many unwise measures of the British Government, of which it is the province of history to preserve the unhappy record, perhaps no one had a more fatal effect in alienating the minds of the colonists, or led more directly or more surely to the great result of separation, than the act of Parliament, passed in the year 1766, known by the name of the *declaratory act*, which, with a strange and blind fatality, accompanied the auspicious repeal of the Stamp Act. By this it was declared, "that the British Parliament had the right to pass laws binding the colonies in all cases whatsoever."

This declaration was in such direct contradiction to the universally received opinion of the British people, that representation, taxation, and legislation, were inseparably connected; that it at once revolted the feelings of all thinking men in the colonies; cancelled the otherwise salutary effect of the repeal of the obnoxious Stamp Act, and gave rise to a series of the most eloquent and powerful essays on the origin, nature, and obligation of government, that had ever before been submitted to the examination of the human understanding. All tended to one point; and error after error on the one hand, confirming the profound reasonings which had thus been provoked on the other, the result became inevitable.

Hostilities commenced at Lexington, on the 19th of April, 1775. On the first news of this affair, the youth and yeomanry of New England hurried to Boston "en masse," with such arms as they could command, and the British troops were shut up in the town, by a numerous assemblage of enthusiastic men, brave, but undisciplined, badly armed, ill-supplied with ammunition, destitute of military uniforms or equipments; cartridges and cartridge-boxes were rare, bayonets almost unknown, and a great proportion of these heroic men possessed only fowling-pieces, with some powder in their horns, and a few bullets in their pockets.

Science was as imperfect among the officers high in command, as was discipline among the inferior officers and troops.

Little was or could be done during the sixty days which elapsed between the 19th of April and the 17th of June, to reduce this assemblage to order and discipline; yet, such was the zeal of the moment, that the determination was taken to advance from Cambridge, and to establish a post on Breed's Hill, the nearest point of approach to Boston, distant a little more than half a mile from the north part of the town; and on the evening of the 16th of June, a detachment of 12 or 1500 men, commanded by Gen. *Putnam* and Col. *Prescott*, marched for this purpose, arrived at the spot selected at 10 o'clock, and commenced throwing up a small redoubt, traces of which were visible a few years since, and probably may still be found on the ground now marked by the monument.

The British had no knowledge of this movement until daylight exposed to their view the progress which had been made; from the moment of this discovery, they opened a heavy fire from ships and batteries, which was continued incessantly through the day, until the attack of the works was made in form by the troops under the command of Gen. Howe, in the afternoon of June 17th. Thus, from 10 o'clock in the evening until 4 o'clock in the morning, *six hours*, was all the time which this gallant detachment had to prosecute their work without interruption. They were not relieved in the morning, but remained all day under the fire of the enemy, laboring to complete their work, which they ultimately defended, under the immediate orders of the gallant veteran, *Prescott*, with the most unyielding bravery; and quitted their post only when their ammunition was entirely expended.

In the course of the day, other troops were ordered down from Cambridge to support this first detachment, some of whom were deterred from attempting to cross Charleston neck, by the fire of the hostile floating batteries; while others fearlessly dashed on, and took up positions on the left of the redoubt, thus forming a line which extended from the redoubt on the right, to Mystic river on the left; securing their front, at least in appearance, by throwing together fences, new-mown hay, and whatever else was movable, and could afford some show of shelter.

Joseph Warren, an eminent physician of Boston, had for some time been distinguished as an ardent and eloquent supporter of the rights of his country. At this time he was a very influential member of the provincial congress, assembled at Watertown, near Cambridge, and a few days preceding the battle had been elected a major-general, but as yet had assumed no command. He was going out to dine, when the increasing din of the action impelled him to gallop to the scene, where he arrived almost at the moment of defeat. This is the moment chosen for the painting, which, of course, is limited to that part of the scene which was near the redoubt, and where the death of Gen. Warren, and the obstinate resistance of men almost unarmed to well-armed and disciplined troops, is meant to be shown.

In a scene of such extent and confusion as the entire battle, half hidden of course by smoke, it was impossible to represent the equal gallantry of those brave troops who formed the line of defense between the redoubt and Mystic river, where Major Knowlton and many others distinguished themselves by the coolest bravery and the soundest judgment.

This painting represents the moment when (the Americans having expended their ammunition) the British troops became completely successful and masters of the field. At this last moment of the action, Gen. Warren was killed by a musket ball through the head. The principal group represents him expiring; a soldier on his knees supports him, and with one hand wards off the bayonet of a British grenadier, who, in the heat and fury natural at such a moment, aims to revenge the death of a favorite officer, Col. Abercrombie, who had just fallen at his feet. Col. Small, (whose conduct in America was always equally distinguished by acts of humanity and kindness to his enemies, as by bravery and fidelity to the cause he served,) had been intimately connected with Gen. Warren,—saw him fall, and flew to save him. He is represented seizing the musket of the grenadier, to prevent the fatal blow, and speaking to his friend: it was too late; the general had barely life remaining to recognize the voice of friendship; he had lost the power of speech, and expired with a smile of mingled gratitude and triumph. Near him, several Americans, whose ammunition is expended, although destitute of bayonets, are seen to persist in a resistance obstinate and desperate, but fruitless. Near this side of the painting is seen Gen. Putnam, reluctantly ordering the retreat of these brave men; while beyond him a party of the American troops oppose their last fire to the victorious column of the enemy.

Behind Col. Small is seen Col. Pitcairn, of the British marines, mortally wounded, and falling in the arms of his son, to whom he was speaking at the fatal moment. Under the feet of Col. Small lies the dead body of Col. Abercrombie.

Gen. Howe, who commanded the British troops, and Gen. Clinton, who, towards the close of the action, offered his service as a volunteer, are seen behind the principal group.

On the right of the painting, a young American, wounded in the sword hand, and in the breast, has begun to retire, attended by a faithful negro; but seeing his general fall, hesitates whether to save himself, or, wounded as he is, to return and assist in saving a life more precious to his country than his own.

Behind this group are seen the British column ascending the hill,—grenadiers, headed by an officer bearing the British colors, mounting the feeble entrenchments; and more distant, the Somerset ship of war, (which lay during the action between Boston and Charlestown,) the north end of Boston, with the battery on Copp's Hill; and the harbor, shipping, &c. &c.

No part of the town of Charlestown is seen; but the dark smoke indicates the conflagration.

Such was the irregularity of official returns at the time, that the number of American troops engaged on this occasion, was never ascertained with any degree of accuracy; they were estimated variously from 1500 to 3000: the latter number was probably nearest the truth. It was admitted that their loss amounted to at least 450 in killed, wounded, and missing; only thirty prisoners, however, fell into the hands of the British, and they were all wounded.

The British Annual Register of that year, admits the number engaged on their side to have been 3000; and states their loss (from official returns) to have amounted to 1054, of whom 226 were killed, and 828 wounded: of this number, 19 officers, including one lieutenant-colonel and two majors, were killed, and 70 others wounded.

The artist was on that day adjutant of the first regiment of Connecticut troops, stationed at Roxbury; and saw the action from that point.

No. 4.—Five Heads. Oil Miniatures.

Major General Gates, 1792.
Colonel William Hull, 1792.
Colonel Ebenezer Stevens, 1791.
Captain Thomas Y. Seymour, 1792.
General John Brooks, 1792.

No. 5.—The Death of Gen. Montgomery, in the attack of Quebec.—*December* 31, 1775.

The history of that part of the war of the Revolution which was carried on in what was called the northern department, is full of events of deep and romantic interest, as well as of important instruction. So early as 1775, in the very first moments of the contest, it was determined to attempt the reduction of Canada, and its annexation to the general confederacy. For this purpose, a body of troops, under the command of General Montgomery, advanced by the obvious route of Lake Champlain, to attack the enemy at the heart, not in the remote extremities: Ticonderoga, St. John's, Chambly, and Montreal, were in his possession on the 12th of November.

In the mean time, an enterprise was planned at Cambridge, and placed under the direction of General Arnold, to co-operate in the reduction of Quebec, which for brilliancy of conception and hardihood of attempt, and for partial, though not ultimate success, may justly be ranked with the passage of the Alps by either the ancient or the modern Hannibal.

The expedition, composed only of 1100 men, left Cambridge, the head-quarters of the grand army, before Boston, on the 13th of September, 1775, embarked at Newburyport, and arrived at the mouth of the Kennebec river on the 20th; ascended that river, then very imperfectly known, through a thinly peopled country, following its course so long as it afforded any facilities of communication or transport; then entering upon a tract of mountainous country, utterly unexplored by civilized man, pursued a course through the wilderness, which their gallant leader, like another Columbus, calculated would lead to those streams, which, running northwardly, must fall into the St. Lawrence: his calculations were correct; he struck upon the head waters of the Chaudiere, which empties into the St. Lawrence, a few miles above, and in sight of the city of Quebec, arrived at Point Levi on the 5th of November, and on the 14th, crossing the river at the head of 500 men, he landed at Wolf's Cove, marched to the plains of Abraham, and presented himself before the walls of the city. The hardships, difficulties, and dangers of this march, had discouraged the last division of troops; and their commander, Col. Enos, yielding to the clamors and despondence of his men, had abandoned the enterprise, and returned to Cambridge. Weakened by this defection, by fatigue, and consequent sickness, General Arnold found himself under the walls of Quebec, at the head of a force too feeble to attempt to take possession of the glorious prize which lay within his grasp, and it became necessary to defer any attack upon the town until the arrival and co-operation of General Montgomery. In the mean time, Sir Guy Carlton, governor of the province, learning the danger of the capital, flew to its aid, and threw himself into the town a few days before the arrival of General Montgomery, and the junction of the American forces, which took place on the first of December. Winter now interposed in vain to suspend the hostile efforts of the combatants.

The term of service for which the American troops had enlisted, generally expired on the 1st day of January, 1776, and it was found that there existed great reluctance to enter into any further engagement. General Montgomery therefore resolved to make one last effort, and in defiance of frost, snow, and tempest, a gallant but desperate attempt was made on the night of the 30th of December to carry Quebec by storm. The attack was made in two columns; one under the immediate command of General Montgomery, attempted the lower town; the other, commanded by General Arnold, was directed against the upper.

The discharge of a single cannon was fatal to General Montgomery and his two aids-du-camp, and this misfortune occasioned the retreat of his column. General Arnold, in the mean time, had been partially successful in his attack, when he was wounded and carried off the field, and the garrison concentrating all their force against his column, they were hemmed in and reduced to the necessity of laying down their arms; and many gallant officers and men remained prisoners of war. Happy would it have been for Arnold, if, instead of being wounded, he too had died, since by his subsequent treason at West Point, he blasted forever the glory of his most gallant conduct on that occasion.

That part of the scene is chosen where General Montgomery commanded in person; and that moment, when by his unfortunate death, the plan of attack was entirely disconcerted, and the consequent retreat of his column decided at once the fate of the place, and of such of the assailants as had already entered at another point.

The principal group represents the death of General Montgomery, who, together with his two aids-du-camp, Major M'Pherson and Captain Cheesman, fell by a discharge of grape-shot from the cannon of the place. The General is represented as expiring, supported by two of his officers, and surrounded by others, among whom is Colonel Campbell, on whom the command devolved, and by whose order a retreat was immediately begun.

Grief and surprise mark the countenances of the various characters. The earth covered with snow,—trees stripped of their foliage,—the desolation of winter, and the gloom of night, heighten the melancholy character of the scene.

No. 6.—Five Heads. Oil Miniatures.

Rufus King, Senator in Congress, 1791.
Fisher Ames, in Congress, 1791.
The Infant, a Chief of the Six Nations, 1792.
John Langdon, Senator in Congress, 1791.
John Brown, Senator in Congress, 1791.

No. 7.—Battle of Princeton,—original composition (partly finished) of No. 23. When the size of the intended copper-plates was determined, the artist resolved in his future pictures to adopt the size of those plates, as being more convenient to the engraver. This picture, which is the same size as the Bunker's Hill and Quebec, and much larger than the copper-plates, is placed in the collection, to explain to future artists the manner of proceeding with the work: they will see that the ground was white on which the work was first merely sketched,—then faintly stained with positive colors,—and finally, each head and figure carefully finished from nature.

No. 8.—Five Heads of Ladies. Oil Miniatures.

Miss Harriet Wadsworth, 1792.
Miss Faith Trumbull, 1791.
Mrs. Faith Trumbull, Lebanon, Conn., 1791.
Miss Catharine Wadsworth, 1791.
Miss Julia Seymour, 1791.

No. 9.—Declaration of Independence.—*July* 4, 1776.

To preserve the resemblance of the men who were the authors of this memorable act, was an essential object of this painting. Important difficulties presented themselves to the artist at the outset; for although only ten years had then elapsed since the date of the event, it was already difficult to ascertain who were the individuals to be represented. Should he regard the fact of having been actually present in the room on the 4th of July, indispensable? Should he admit those only who were in favor of, and reject those who were opposed to the act? Where a person was dead, and no authentic portrait could be obtained, should he admit ideal heads? These were questions on which Mr. Adams and Mr. Jefferson were consulted, and they concurred in the advice, that with regard to the characters to be introduced, the signatures of the original act, (which is still preserved in the office of state,) ought to be the general guide. That portraits ought, however, to be admitted, of those who were opposed to, and of course did not sign, as well as of those who voted in favor of the Declaration, and did sign it, particularly John Dickinson, of Delaware, author of the Farmer's Letters, who was the most eloquent and powerful opposer of the measure; not indeed of its principle, but of the fitness of the time, which he considered premature. And they particularly recommended, that wherever it was possible, the artist should obtain his portrait from the living person; that where any one was dead he should be careful to copy the finest portrait that could be obtained; but that in case of death, where no portrait could be obtained, (and there were many such instances, for, anterior to the Revolution, the arts had been very little attended to, except in one or two of the cities,) he should by no means admit any ideal representation, lest, it being known that some such were to be found in the painting, a doubt of the truth of others should be excited in the minds of posterity; and that, in short, absolute authenticity should be attempted, as far as it could be obtained.

The artist was governed by this advice, and spared neither labor nor expense in obtaining his portraits from the living men. Mr. Adams was painted in London; Mr. Jefferson in Paris; Mr. Hancock and Samuel Adams in Boston; Mr. Edward Rutledge in Charleston, South Carolina; Mr. Wythe at Williamsburgh, in Virginia; Mr. Bartlett at Exeter, in New Hamphire, &c. &c. &c.

In order to give some variety to his composition, he found it necessary to depart from the usual practice of reporting an act, and has made the whole committee of five advance to the table of the president, to make their report, instead of having the chairman rise in his place for the purpose: the silence and solemnity of the scene, offered such real difficulties to a picturesque and agreeable composition, as to justify, in his opinion, this departure from custom, and perhaps fact. Silence and solemnity he thought essential to the dignity of the subject; levity or inattention would have been unworthy on such an occasion and in such an assembly. The dresses are faithfully copied from the costume of the time, the present fashion of pantaloons and trowsers being then unknown among gentlemen.

The room is copied from that in which Congress held their sessions at the time, such as it was before the spirit of innovation laid unhallowed hands upon it, and violated its venerable walls by modern improvement, as it is called.

The artist also took the liberty of embellishing the back-ground, by suspending upon the wall, military flags and trophies: such had been taken from the enemy at St. John's, Chambly, &c. and probably were actually placed in the hall.

In fact nothing has been neglected by the artist, that was in his power, to render this a faithful memorial of the great event.

No. 10.—Five Heads. Oil Miniatures.

Signor Cerrachi, Sculptor, 1792.
J. Dalton, Senator in Congress, 1791.
The Young Sachem, a Chief of the Six Nations, 1792.
Theodore Sedgwick, in Congress, 1791.
Oliver Ellsworth, Senator in Congress, 1791.

No. 11.—Capture of the Hessians at Trenton.—*December 26, 1776.*

The campaign of 1776 was one continued series of disasters. The defeat on Long Island, the loss of New York, the indecisive battle at White Plains, and the capture of Fort Washington, were followed by a rapid retreat through New Jersey; and the fragments of the army did not feel themselves safe until they had crossed the Delaware, and secured upon the west side of the river, all the boats which were to be found. Here the exhausted troops enjoyed a few days of repose, and were joined by some reinforcements from Pennsylvania, Maryland and Virginia, and by such part of the northern army, under General Gates, as could be spared from that quarter; the entire force when united, amounting to perhaps 4 or 5000 men.

The enemy, in the mean time, finding it impossible to cross the Delaware, and push on immediately to Philadelphia, as they had intended, left a strong corps of Hessian troops commanded by Col. Rahl, at Trenton, and another, also Hessians, commanded by Col. Count Donop, at Bordentown, and withdrew their main force to Brunswick, where they established their magazines, &c.

Washington, now like a chafed lion, meditated vengeance against his pursuers; and having ascertained the position and strength of his enemy in Trenton and Bordentown, and that it consisted entirely of German troops, who were accustomed to keep Christmas with great festivity, he determined upon attempting to surprise them on the following morning, when the revelry of the night would probably leave them off their guard. The necessary dispositions were accordingly made for crossing the Delaware, in three divisions; one near Bordentown, one just below Trenton, and the principal force, under his own personal command, some few miles above Trenton. The night proved tempestuous, with snow and hail. The river was rendered almost impassable by drifting ice, and thus the elements conspired to remove from the minds of the devoted Germans all apprehensions of an attack. The division under the immediate command of Washington, crossed the river with great difficulty, marched down on the east shore, and were not discovered until they presented themselves at the northern extremity of the town, a little before sunrise. The Germans, particularly the regiment of Rahl, flew to arms, and for a few minutes made a very spirited but ineffectual resistance. The attack was completely successful; and the principal part of the three German regiments, of Rahl, Lossberg, and Knyphausen, to the number of 918, were made prisoners: in killed and wounded they lost 30 or 40 men; the remainder escaped across the creek down the river, and joined their comrades at Bordentown,—the meditated attack on that post having been prevented by the impossibility of crossing the river.

Six light battalion brass cannon also fell into the hands of the victor, whose loss was trifling. Two officers were wounded,—Mr. Monroe, late president of the United States, then a captain in the Virginia troops, dangerously, and Wm. Washington, then a lieutenant, afterwards the celebrated cavalry officer, slightly.

When the conflict was ended, General Washington walked his horse over the field, to see that the wounded were properly attended to. Among them he observed an officer richly dressed in the hostile uniform, and upon inquiry, found that this was Col. Rahl, commanding officer of the enemy. He immediately called one of his aids-du-camp, Col. William Smith, and gave this memorable order: "Smith, take charge of this gentleman; see him carefully and kindly conveyed to a house; call our best surgeons to his assistance, and let us save his life if possible." Col. Rahl died in the afternoon, but the memory of this act should never die.

The magnanimous kindness displayed by Washington, on this occasion, offers a sublime example of true heroism, and well deserves to be imitated by all military men. The artist chose this subject, and composed the picture for the express purpose of giving a lesson to all living and future soldiers in the service of his country, to show mercy and kindness to a fallen enemy,—their enemy no longer when wounded and in their power.

In the afternoon the army re-crossed the Delaware, with the trophies of their victory, and the next day the prisoners and artillery which had been taken were marched off to Philadelphia, where their arrival caused the most unbounded joy.

No. 12.—FOUR HEADS. Oil Miniatures.

THOMAS PINCKNEY, Minister to Great Britain, 1791.
Judge JOHN RUTLEDGE, 1791.
CHARLES COTESWORTH PINCKNEY, 1791.
General MOULTRIE, 1791.

No. 13.—Copy of the TRANSFIGURATION, the celebrated masterpiece of Raphael.

No. 14.—Copy of CORREGGIO'S* celebrated picture, called the ST. JEROME, AT PARMA. Painted in Tothill Fields Prison, near London, where the artist was confined on the charge of High Treason, during the winter of 1781.

No. 15.—Copy of the most admired picture of RAPHAEL, called the "MADONNA DELLA SEDIA"—i. e. "OUR LADY OF THE CHAIR." Painted in London, October, 1780, in the house and under the eye of Mr. West.

No. 16.—Copy of the COMMUNION OF ST. JEROME, the masterpiece of DOMINICHINO. (See the Appendix.)

No. 17.—Portrait of COL. TRUMBULL, by Waldo and Jewitt.

No. 18.—Portrait of Mrs. TRUMBULL, by the Colonel.

No. 19.—PREPARING THE BODY OF OUR SAVIOR FOR THE TOMB.

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* Correggio was born in 1494, at Correggio, a small town in the Duchy of Modena. His real name was Antonio Allegri, de Correggio, or of Correggio, according to the Italian and French custom. He died in 1534, at the age of 40, and was, therefore, cotemporary with Raphael, M. Angelo, Titian, &c. His master in the art was an unimportant artist in Modena, from whom he learned little, but formed a style of his own; in which were united truth and purity of color, grace, and elegance of design, sweetness of expression, and a superior knowledge of light and shadow. He wanted only correctness of drawing to have rendered him superior even to Raphael. The little Madonna and infant Savior in the gallery at New Haven was copied from a copy made by Mr. West, from the original, which is preserved at Parma, and is allowed by all connoisseurs, to be one of the three finest paintings in existence: the other two pictures are the transfiguration, by Raphael, and the communion of St. Jerome, by Dominichino; which of these three is the best, is undecided.

No. 20.—Copy of the MADONNA* AU CORSET ROUGE—a favorite composition of Raphael. Done in London, 1801.

No. 21.—OUR SAVIOR BEARING THE CROSS, AND SINKING UNDER ITS WEIGHT. Painted in New York, 1826.

No. 22.—FOUR HEADS. Oil Miniatures.

RUFUS PUTNAM, Brigadier General, first settler of Ohio.
JACOB REED, Esq., in Congress, 1792.
RALPH IZARD, Senator in Congress, 1791.
Judge GRIMKE, of Charleston, South Carolina.

No. 23.—DEATH OF GEN. MERCER, AT THE BATTLE OF PRINCETON. *January* 3, 1777.

Alarmed by the success of the attack upon Trenton, the enemy immediately withdrew all their posts from the banks of the Delaware, and concentrated their forces in Princeton and Brunswick. On the other hand, Gen. Washington, having received considerable reinforcements, re-crossed the river, and again took possession of Trenton, with a view to further offensive operations. On the 2d of January, 1777, Lord Cornwallis, having resumed the command of the British troops, marched with his whole force to attack him. Washington, at his approach, abandoned the town of Trenton, and took his position on the south side of the creek. Some skirmishing followed, and a severe cannonade, with an unsuccessful attempt to force the passage of the bridge, closed the events of the day. The British troops, to the number of near 10,000, occupied Trenton. One brigade was halted about six miles in their rear, and another brigade, composed of the 17th, 40th and 55th regiments, under the command of Col. Mawhood, passed the night at Princeton. All these corps were ordered to unite at Trenton early in the following morning, with the expectation of overwhelming the Americans.

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* Madonna is technically applied by the Italians to the Virgin Mary, the mother of *our Lord*, and therefore emphatically *our Lady; ma*, in Italian, is my, and *Donna*, Lady, literally therefore, *my Lady*. The Madonna with the infant Jesus, has always been a favorite subject with the Italian artists; since, independently of religious motives, it is a subject which unites in one group, the two most beautiful objects in nature, a beautiful woman and a lovely infant.

Gen. Washington saw his danger. The troops he commanded were very inferior in number, as well as in discipline and in arms. The Delaware had become absolutely impassable in the presence of such an enemy. To retreat down the east bank, and attempt to cross at or near Philadelphia, was equally hopeless; and he resolved to extricate himself by falling into the rear of the enemy, and by breaking the line of his communications, forcing him in his turn to abandon his favorite attempt on Philadelphia, for the security of his own magazines and depots at Princeton and Brunswick. In execution of this daring and almost desperate plan, he took the necessary precaution for keeping up the fires, and every other appearance of still occupying his camp; and leaving small parties commanded by confidential officers to go the rounds and guard the bridge and fords, he withdrew his troops in the dead of night, with the most profound silence; and commenced his march to the east, keeping the creek between him and his enemy.

On the morning of the 3d of January, a little before sunrise, and at a short distance from Princeton, the leading division, under the command of Gen. Mercer, fell in with the 17th British regiment, commanded by Col. Mawhood, who had just commenced their march to join Lord Cornwallis at Trenton. The meeting was equally unexpected to both parties, and both for a moment were disconcerted; but they met on very unequal terms. The British had slept warm at Princeton, had breakfasted, and were in high spirits, with the expectation of a certain and decisive victory; while the Americans, having marched all night, were benumbed with cold, exhausted with fatigue and hunger, and felt little anticipation but of defeat. A deadly conflict was unavoidable, and was maintained by the Americans with the courage of desperation, until the horse of Gen. Mercer was killed under him; and before he could disengage himself, and get upon his feet, he was attacked by two grenadiers, and mortally wounded. The division, upon the loss of their commander, gave way, and for a moment the British were triumphant.

Washington saw the imminence and extent of the danger, and the utter irretrievable ruin to the cause of his country, which would be the consequence of ultimate defeat; and having formed the troops which followed into a close column, he placed himself at their head, and advanced to meet the enemy. A sanguinary and obstinate struggle followed, in which the 17th British regiment was nearly annihilated; the 55th was not much less severely cut up, and with difficulty effected a retreat on Brunswick; to which place the 40th also escaped by a circuitous road, and with less loss.

The loss of lives was considerable on both sides; 200 prisoners remained in the hands of the Americans, who immediately continued their march, with the intention of pushing on to Brunswick, and there burning the enemy's magazines; but upon examining the condition of the troops during a short halt at Kingston, it was found, that although they were in high spirits, yet their physical force was too far exhausted by cold, fatigue, and hunger. Their march might be traced upon the frozen ground by the blood from their lacerated feet; their shoes, as well as other clothing, being utterly inadequate to the extreme rigor of the season; in addition to which, their ammunition was found to be nearly exhausted. Under these circumstances, the attempt upon Brunswick was reluctantly abandoned, and the army filed off to the north by an obscure road opposite to the stage-house in Kingston, and took up a strong position in the hilly country towards Morristown.

In the mean time, Lord Cornwallis, secure of his prey, waited with impatience for morning, when he was astonished by a heavy firing far in his rear; and upon examination found that his enemy was gone, and that nothing remained of the hostile camp but the ashes of the fires by which he had been deluded. He instantly comprehended the nature and extent of the evil,—that Princeton and Brunswick were exposed to imminent danger, and without one moment of unnecessary delay, he commenced his retrograde march for their relief. In a few days, the British army, lately so triumphant, was reduced to the very narrow limits of Brunswick and Amboy, owing their security even in them, principally to the open communication with New York by sea; while the Americans occupied all other points of East as well as of West Jersey, and often insulted their enemy within their narrow quarters.

Thus, in the short space of nine days, an extensive country, an entire State, was wrested from the hands of a victorious enemy, superior in numbers, in arms, and in discipline, by the wisdom, activity, and energy of one great mind.

It is not too much to say, that in the history of war, it would be difficult to find a parallel event; even in the history of Napoleon, whom mankind have agreed to view with such blind admiration. He was at the head of a nation which had made war a scientific study for ages,—a nation abounding in men at once enthusiastic and disciplined, as well as in all the munitions and equipage of war. With such means at his disposal, the success of Bonaparte ought not to excite surprise. But his history offers no point, when, with inferior and inadequate means, he baffled a victorious enemy, and wrested from him, as in a moment, the fruits of an arduous and successful campaign.

No. 24.—Five Heads of Ladies. Oil Miniatures.

Miss Ellen Custis, grand-daughter of Mrs. Washington, 1790.
Miss Cornelia Schuyler, daughter of the General, 1791.
Mrs. Martha Washington, 1791.
Miss Sophia Chew, of Philadelphia, 1792.
Miss Harriet Chew, 1792.

No. 25.—Surrender of General Burgoyne.—*October* 16, 1777.

The conquest of Canada was, from the day of the unfortunate attack on Quebec, an idle dream; it was well known that in May reinforcements would arrive from England; yet great but ineffectual efforts were made on the American side; and General Thomas first, and afterwards Gen. Sullivan, were sent on with very considerable forces. The small-pox and sickness, joined with the efforts of the enemy to render a retreat as dangerous and difficult as it was necessary. Gen. Thomas died, and the broken fragments of the invaders fell back upon Crown Point and Ticonderoga; where in the beginning of July, they were met by Gen. Gates, who had been sent to assume the command of the northern department.

His first object was of course to obtain a return of the force and condition of the army. It was found to consist of 5200 men, of whom about 2800 were so sick as to require to be sent to the hospital, which had been established at the head or southern extremity of Lake George; and when these, with the number necessary to serve as nurses, were removed, the force remaining for active service was too small to offer any effectual resistance to the victorious enemy, had he possessed the means of following up his success. Happily, General Sullivan, on whom had devolved the command of this disastrous retreat, had with great skill and exertion, found means either to destroy or withdraw all the vessels and boats on Lake Champlain, so that the victors were compelled to remain at St. John's until they could construct others.

The summer was passed by the contending parties, at the two extremities of the lake, in preparations to give or repel the attack; the works at Ticonderoga were strengthened, and each endeavored to secure the command of the lake by constructing a fleet; these met on the 11th of October, when the American squadron was defeated, and the enemy advanced to Crown Point, and reconnoitered Ticonderoga. But the lateness of the season, and the formidable display of apparent force on our side, deterred Sir Guy Carlton from making an attack. The defenses of this post had been so extended as to require at least 10,000 men, and they were occupied for a short time by 13,500, chiefly New England militia. It was not only believed by some, but at length demonstrated by actual experiment, that this extended position was overlooked and completely commanded by Sugar-Loaf Hill, which forms the northern extremity of that mountain ridge which separates Lake George from Wood Creek, the southern and narrow part of Champlain; and this important point, elevated six hundred feet above the level of the water, had never been occupied by French, English, or Americans.

The spring of 1777 found General St. Clair occupying the extensive works of Ticonderoga with only 3000 men, all the force that could be spared for the defense of that point.

On the first of July, General Burgoyne appeared before the place at the head of 8000 men, and immediately occupied Mount Hope, on the left of our position, distant about 1000 yards from the old French lines, so memorable for the defeat of General Abercrombie, in 1757. He was thus master of the outlet of Lake George, and on the next night he occupied the summit of Sugar-Loaf Hill, with several pieces of heavy artillery, and from that moment it became unavoidably necessary to abandon Ticonderoga. This was effected in the course of the following day by General St. Clair, with as little loss or disorder as could be expected under such circumstances; the troops commenced their retreat on the east side of the lake, and after various skirmishes and some loss, fell back as far as Stillwater, on the North River, twenty miles above Albany; here they were met by reinforcements and halted, and General Gates again assumed the command.

General St. Clair was very severely censured for thus losing this important post. But his means were entirely inadequate to its defense; he merited applause rather for having extricated himself with so little loss from a very difficult situation, and for having saved part of the garrison which formed the nucleus of that force, which, before the close of the campaign, reversed its character.

General Burgoyne followed up his success with great caution, advancing slowly, and bringing on his entire park of artillery, with all its attirail; but it was not until September, that he approached General Gates, at Stillwater, where a partial and indecisive action took place on the 20th. On the 7th of October, a decisive action was fought at Bemus's Heights. On the 8th, General Burgoyne found his situation so critical, that he abandoned his camp, and commenced a retreat toward Canada; but finding bad roads, broken bridges, and hostile parties posted at every disputable point, and hovering around him on all sides, he halted, and took post at Saratoga, where, on the 17th, his army surrendered, under a convention, of which the following were the first two articles.

ARTICLES OF CONVENTION BETWEEN LIEUTENANT-GENERAL BURGOYNE AND MAJOR-GENERAL GATES.

"1. The troops under Lieutenant-General Burgoyne, to march out of their camp with the honors of war, and the artillery of the intrenchments, to the verge of the river where the old fort stood, where the arms and artillery are to be left; the arms to be piled by word of command from their own officers.

"2. A free passage to be granted to the army under Lieutenant-General Burgoyne to Great Britain, on condition of not serving again in North America during the present contest; and the port of Boston is assigned for the entry of transports to receive the troops, whenever General Howe shall so order."

The painting represents General Burgoyne, attended by General Phillips, and followed by other officers, arriving near the marquée of General Gates.

General Gates has advanced a few steps from the entrance, to meet his prisoner, who, with General Phillips, has dismounted, and is in the act of offering his sword, which General Gates declines to receive, and invites them to enter, and partake of refreshments. A number of the principal officers of the American army are assembled near their general.

The confluence of Fish Creek and the North River, where the British left their arms, is shown in the distance, near the head of Col. Scammell; the troops are indistinctly seen crossing the creek and the meadows, under the direction of Colonel (since Governor) Lewis, then quarter-master general, and advancing towards the fore-ground: they disappear behind the wood, which serves to relieve the three principal figures; and again appear, (grenadiers, without arms or accoutrements,) under the left arm of General Gates. Officers on horseback, American, British, and German, precede the head of the column, and form an interesting cavalcade, following the two dismounted generals, and connecting the different parts of the picture.

No. 26.—Five Heads. Oil Miniatures.

Brigadier General Smallwood.
Major Haskell.
Colonel Morgan, of the Rifle Corps.
Judge Egbert Benson, in Congress, 1791.
Major General Philip Schuyler.

No. 27.—The Death of Paulus Emilius, at the battle of Cannæ, arranged and painted at the age of eighteen, before the artist had received any instruction. The arrangement or composition of this early picture is all that is original: the parts or separate figures were chosen from various engravings. See Rollin's Roman History, book 14th, sec. 2d, page 64 of the 2d London edition. The earliest composition of the artist. Painted at Lebanon, 1774.

"animæque magnæ,
Prodigum Paulum, superante Pœno."
Horace, Book 1, *Ode* 12, *l.* 37, 38.

No. 28.—Five Heads. Oil Miniatures.

Jonathan Trumbull, Speaker of the U. S. House of Representatives, 1792.

Jonathan Trumbull, Governor of Connecticut during the Revolution.

Good Peter, a Chief of the Six Nations. 1792.

Dr. Lemuel Hopkins, of Hartford, poet and physician.

John Trumbull, author of Mc Fingal.

No. 29.—Surrender of Lord Cornwallis.—*October* 19, 1781.

The success of this officer in the southern States, during the years 1780 and 1781, the capture of Charleston, the victory of Camden, and various minor successes, by which almost every part of Georgia and South and North Carolina, had been successively occupied by the British troops, had seriously threatened the ruin of American independence.

In 1781, Lord Cornwallis, regarding his presence as no longer essential to the complete reduction of the three southern States, marched with the principal part of his force into Virginia, where, for some time, his success was almost equally rapid and complete; but the admirable combined movement of General Washington and our French allies, from the north, and of the Count de Grasse, with the fleet and army of France, from the West Indies, turned the scale, and rendered it necessary for him to shut himself up in Yorktown, and attempt to defend himself there, until he could receive relief from New York. This hope, however, failed him, and on the 19th of October, he surrendered his forces to the combined armies of America and France.

The honor of marching out of the town, with colors flying, &c. &c., which had been refused to General Lincoln, when, during the preceding campaign, he had surrendered Charleston, was now refused to Lord Cornwallis; the terms of the capitulation dictated at Charleston were insisted on, and General Lincoln was appointed to superintend the submission of the British at Yorktown, in the same manner as that of the American troops at Charleston, under his command, had been conducted about eighteen months before.

The American troops were drawn up on the right of the road leading into York; General Washington and the American general officers on the right. The French troops on the opposite side of the road facing them; General Rochambeau and the principal officers of the French navy and army on the left. The

British troops marched out of town, "with shouldered arms, colors cased, and drums beating a British or German march," passed between the two lines of victorious troops, to a place appointed, where they grounded their arms, left them, and returned unarmed to their quarters in the town.

The painting represents the moment when the principal officers of the British army, conducted by General Lincoln, are passing the two groups of American and French generals, and entering between the two lines of the victors; by this means the principal officers of the three nations are brought near together, so as to admit of distinct portraits.

In the centre of the painting, in the distance, is seen the entrance of the town, with the captured troops marching out, following their officers: and also a distant glimpse of York River, and the entrance of the Chesapeake Bay, as seen from the spot.

No. 30.—Five Heads. Oil Miniatures.

Judge Oakley, 1827.
Henry Dwight, M. C., 1827.
John C. Calhoun, Vice President of the United States, 1827.
Dr. Allen, 1827.
David B. Ogden, Esq., 1827.

No. 31.—Resignation of Gen. Washington.—*December* 23, 1783. *Washington*, 1827.

The peace of 1783 had accomplished the great object of the American Revolution; the former colonies were acknowledged by the parent state to be independent of her; but they were equally independent of each other, and the pressure of common danger, which had been the strongest bond of union, being removed, there remained only a feeble and doubtful sense of common interest to hold the different states together; the large states began to feel their real superiority, while the memory of faithful and disproportioned services swam before the vision of the small; the seeds of discord were sown and germinating. The army, whose fidelity, patience, and courage, had won the glorious prize, had leisure to look back upon the years, during which, without pay, without clothing, and sometimes almost without food, they had persevered in duty,—tantalized with promises, often renewed under various forms, but never fulfilled, they saw themselves on the point of being disbanded, and by being scattered among the mass of their fellow-citizens, deprived of any chance of obtaining justice by the influence of a united effort; nor were there wanting among them fiery spirits, to place all this distinctly before their view, and to urge them not to lay down their arms or disperse, until substantial justice should be obtained. What a dazzling temptation was here to earthly ambition! Beloved by the military, venerated by the people, who was there to oppose the victorious chief, if he had chosen to retain that power which he had so long held with universal approbation? The Cæsars, the Cromwells, the Napoleons, yielded to the charm of earthly ambition, and betrayed their country; but Washington aspired to loftier, imperishable glory,—to that glory which virtue alone can give, and which no power, no effort, no time, can ever take away or diminish.

After taking an affectionate leave of his old comrades at New York, accompanied by only two of them, Col. Benjamin Walker and Col. Humphreys, aids-du-camp, he proceeded to Annapolis, where Congress, the very shadow of a government, were then sitting, and there resigned his commission into the hands of twenty-three powerless men, divested himself of all authority, and retired to private life.

The following impressive history of the scene is copied from the Journal of Congress, and has been the basis of the picture. One additional circumstance deserves notice, not so much for its importance as for its singularity. Thomas Mifflin, then president of Congress, and into whose hands the general resigned his commission, had been, in 1775, his first aid-du-camp, and he who painted the picture had been his second.

Extract from the Journal of Congress, Dec. 23, 1783.

According to order, his Excellency, the commander-in-chief, was admitted to a public audience, and being seated, the President, after a pause, informed him that the United States, in Congress assembled, were prepared to receive his communications; whereupon he arose and addressed Congress as follows:—

Mr. President,

The great events on which my resignation depended, having at length taken place, I have now the honor of offering my sincere congratulations to Congress, and of presenting myself before them to surrender into their hands the trust committed to me, and to claim the indulgence of retiring from the service of my country.

Happy in the confirmation of our independence and sovereignty, and pleased with the opportunity afforded the United States of becoming a respectable nation, I resign with satisfaction the appointment I accepted with diffidence,—a diffidence in my abilities to accomplish so arduous a task; which, however, was superseded by a confidence in the rectitude of our cause, the support of the supreme power of the Union, and the patronage of heaven.

The successful termination of the war has verified the most sanguine expectations; and my gratitude for the interposition of Providence, and the assistance I have received from my countrymen, increases with every review of the momentous contest.

While I repeat my obligations to the army in general, I should do injustice to my own feelings not to acknowledge in this place, the peculiar services and distinguished merits of the gentlemen who have been attached to my person during the war. It was impossible that the choice of confidential officers to compose my family should have been more fortunate. Permit me, sir, to recommend in particular, those who have continued in the service to the present moment, as worthy of the favorable notice and patronage of Congress.

I consider it an indispensable duty to close this last act of my official life by commending the interests of our dearest country to the protection of Almighty God, and those who have the superintendence of them to his holy keeping.

Having now finished the work assigned me, I retire from the great theatre of action, and bidding an affectionate farewell to this august body, under whose orders I have so long acted, I here offer my commission, and take my leave of all the employments of public life.

He then advanced and delivered to the President his commission, with a copy of his address, and having resumed his place, the President returned him the following answer:—

Sir,—The United States, in Congress assembled, receive with emotions too affecting for utterance, the solemn resignation of the authorities under which you have led their troops with success, through a perilous and doubtful war. Called upon by your country to defend its invaded rights, you accepted the sacred charge before it had formed alliances, and whilst it was without funds or a government to support you; you have conducted the great military contest with wisdom and fortitude, invariably regarding the rights of the civil power through all disasters and changes. You have, by the love and confidence of your fellow-citizens, enabled them to display their martial genius, and transmit their fame to posterity. You have persevered till these United States, aided by a magnanimous king and nation, have been enabled, under a just Providence, to close the war in freedom, safety, and independence; on which happy event we sincerely join you in congratulations.

Having defended the standard of liberty in this new world, having taught a lesson useful to those who inflict, and to those who feel oppression, you retire from the great theatre of action with the blessings of your fellow-citizens: but the glory of your virtues will not terminate with your military command,—it will continue to animate remotest ages.

We feel with you our obligations to the army in general, and will particularly charge ourselves with the interests of those confidential officers, who have attended your person to this affecting moment.

We join you in commending the interests of our dearest country to the protection of Almighty God, beseeching him to dispose the hearts and minds of its citizens to improve the opportunity afforded them of becoming a happy and respectable nation. And for you, we address to him our earnest prayers, that a life so beloved may be fostered with all his care; that your days may be as happy as they have been illustrious; and that he will finally give you that reward which this world cannot give.

No. 32.—Five Heads. Oil Miniatures.

Major General Mifflin, President of Congress, 1792.
J. Livermore, Senator in Congress, 1791.
Captain Manning, of Lee's legion, 1791.
General Butler, 1792.
Arthur Lee, Esq., 1790.

No. 33.—Hon. Stephen Van Rensselaer.

No. 34.—The Woman accused of having been taken in Adultery.—*St. John*, viii, 2—11. London, 1811.

"And the Scribes and Pharisees brought unto him a woman taken in adultery; and when they had set her in the midst, they say to him, Master, this woman was taken in adultery, in the very act: now, Moses in the law commanded us that such should be stoned; but what sayest thou? This they said, tempting him, that they might have whereof to accuse him: so when they continued asking him, he lifted himself up and said unto them: *He that is without sin among you, let him first cast a stone at her.* And they which heard, being convicted by their own conscience, went out one by one."

No. 35.—St. John and Lamb,—from memory of an exquisite picture by Murillo, in possession of the emperor of Russia. Painted in London, 1800.

No. 36.—Portrait of President Washington,—head, the size of life. Painted in Philadelphia, May, 1793.

No. 37.—The Earl of Angus, conferring Knighthood on De Wilton. See Sir Walter Scott's Marmion.—Painted in London, 1810.

"A Bishop by the altar stood,
A noble lord of Douglas' blood;
With mitre sheen, and rocquet white,
Yet showed his meek and thoughtful eye,
But little pride of prelacy," &c. &c.

"Beside him, ancient Angus stood,
Doff'd his furr'd gown and sable hood:
O'er his huge form and visage pale,
He wore a cap and shirt of mail;
And lean'd his large and wrinkled hand
Upon his huge and sweeping brand," &c. &c.

"Then at the altar Wilton kneels,
And Clare the spurs bound on his heels;
And think what next he must have felt,
At buckling of the falchion belt;
And judge how Clara changed her hue," &c. &c.

Scott's Marmion, Canto 6, *Stanzas* 11 *and* 12.

No. 38.—Portrait of Alexander Hamilton, copied in 1832, from an original, painted at Washington in 1792, now in possession of the family of the late Gov. Wolcott.

No. 39.—Holy Family,—composed in London, 1802,—finished in America, 1806.

No. 40.—President Dwight.

Timothy Dwight, D. D., LL. D., was born at Northampton, in Massachusetts, on the 4th of May, A. D. 1752. His parents were Timothy and Mary Dwight. The first ancestor of his father's family, in this country, John Dwight, came from England, and settled in Dedham, in Massachusetts, in 1637. His mother was the third daughter of Jonathan Edwards, President of Princeton College, New Jersey. Dr. Dwight entered Yale College in 1765, and graduated in 1769, with a high reputation for scholarship. Two years afterwards, he was chosen a tutor of Yale College, and for the six succeeding years discharged the duties of this office with distinguished success. In March, 1777, he was married to Miss Mary Woolsey, daughter of Benjamin Woolsey, Esq., of Long Island. In September of the same year, he was chaplain to Gen. Parsons' brigade, which was a part of the division of General Putnam, in the army of the United States, and served one year. After this, he resided several years at Northampton, and was twice a member of the legislature of Massachusetts. In 1783, he was ordained as minister of the church and congregation of the parish of Greenfield, in the town of Fairfield in Connecticut, and for the succeeding twelve years continued their pastor. While at Greenfield, he established an academy, which enjoyed a high reputation.

In May, 1795, on the death of the Rev. Dr. Stiles, he was invited to the presidency of Yale College. Much was expected from Dr. Dwight in this situation, and public expectation was in no respect disappointed. By his exertions as an instructor, and by a judicious system of discipline, the reputation of the College was greatly increased and extended. Dr. Dwight, through the whole time of his presidency, discharged, also, the duties of a Professor of divinity. In the midst of his usefulness, he was attacked by a painful and incurable disorder, which terminated his life on the 11th of January, 1817, in the 65th year of his age. His death was very extensively and deeply lamented. Since the decease of Dr. Dwight, his lectures on divinity have been published under the title of 'Theology,'—likewise two volumes of 'Sermons,' and his 'Travels in New England and New York.' In early life, he published an epic poem, entitled the 'Conquest of Canaan,' and while he resided at Greenfield, a collection of poems entitled 'Greenfield Hill.' He published also at different times, numerous occasional sermons and short treatises.

This picture was, in part, presented to the College by individuals of the class which graduated in 1817.

No. 41.—Portrait of General Washington,—whole length, the size of life, painted at Philadelphia, in the year 1792, for the city of Charleston, (S. C.)

This picture was intended to preserve the *military* character of the great original; but the citizens of Charleston being desirous of seeing him rather in his civil character, such as they had recently seen him in his visit to that city, another picture, was, with the kind consent of the President, begun and finished, which now hangs in some public building at Charleston; this was also finished, and with his approval, remained in the hands of the artist, who had formerly been his aid-du-camp.

He is represented in full uniform, standing on an eminence, on the south side of the creek at Trenton, a small distance below the stone bridge and mill. He holds in his right hand his reconnoitering glass, with which he is supposed to have been examining the strength of the hostile army, pouring into and occupying Trenton, which he had just abandoned at their approach; and having ascertained their great superiority, as well in numbers as in discipline, he is supposed to have been meditating how to avoid the apparently impending ruin. To re-cross the Delaware in the presence of such an enemy, was impossible; to retreat down the eastern side of the river, and cross at Philadelphia, was equally so; to hazard a battle on the ground, was desperate; and he is supposed to have just formed the plan of that movement which he executed during the succeeding night. This led to the splendid success at Princeton, on the following morning; and in the estimation of the great Frederick of Prussia, placed his military character on a level with that of the greatest commanders of ancient or modern times.

Behind and near him an attendant holds his horse; further back, are seen artillery, assisting in the defense of the bridge and mill, against the attack made by the enemy, a little before sunset; the bridge and mill are seen under the legs of the horse, and higher up in the perspective distance, are seen several glimpses of the creek in its windings; and the fires which so fatally deluded the enemy during the night, are in many places already lighted and visible.

In the countenance of the hero, *the likeness*, the mere map of the face, was not all that was attempted, but the features are animated, and exalted by the mighty thoughts revolving in the mind on that sublime occasion; *the high resolve*, stamping on the face and attitude its lofty purpose, to conquer or to perish.

Every minute article of the dress, down to the buttons and spurs, and every strap and buckle of the horse-furniture, were carefully painted from the several objects.

The picture remained in the possession of Colonel Trumbull until the dissolution of the Society of the Cincinnati in Connecticut, when His Excellency Governor Trumbull, Gen. Jedediah Huntington, the Hon. John Davenport, the Hon. Jeremiah Wadsworth, and the Hon. Benjamin Talmadge, joined with him in presenting this portrait to Yale College.

No. 42.—Governor Trumbull, Sen.

Jonathan Trumbull was born at Lebanon in 1710, the son of Joseph, a respectable and strong-minded farmer, who, feeling the deficiency of his own education, resolved that his son should not suffer similar mortifications from that cause. He therefore spared no care or expense in his education, and at an early age the favored boy was sent to Harvard College. Here he became a good scholar, acquiring a knowledge of the Hebrew, as well as the Greek and Latin languages, and of all the other studies of the day. He graduated with honor in 1727.*

His original destination was for the pulpit. He went through the preparatory studies, and had commenced preaching, when an elder brother (Joseph) who had been engaged in commerce, died suddenly, leaving extensive business in an unsettled state, and Jonathan was the only member of the family qualified to unravel

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* In the same class was Governor Hutchinson.

these complicated affairs: he of course devoted himself to this duty, and was at length so involved in commercial questions and occupations, that he quitted his early and favorite pursuit, and became a merchant.

He was early elected by his townsmen to the lower political offices of the town; he soon became one of their representatives in the Colonial Assembly; and as his talents and virtues became more extensively known, he was appointed one of the Judges, then a member of the Council or State Senate; and at length Deputy or Lieutenant Governor, in which office he stood at the commencement of the disputes between Great Britain and her colonies. In this controversy, he embraced with fervor the patriotic side; became Governor of the State by the free election of his countrymen, and continued to be annually elected Governor until the close of the Revolution in 1783, when, declining a further election, he withdrew from public life, devoted his last years to study and religion, and died at Lebanon in August, 1785, at the age of 75 years.

After General Washington, perhaps no individual contributed more to the success of the Revolution than Governor Trumbull. He was always at his post, and devoted his time, his talents, and his influence, with undivided energy and assiduity to the service of his country; his example had a powerful influence on the State, and on all New England.

His correspondence was very extensive, and is preserved in many manuscript volumes, which were given by his family to the Historical Society in Boston, where, it is to be presumed, they are preserved with the care they deserve.

Governor Trumbull in early life married Faith, daughter of the Rev. John Robinson, of Duxbury, Mass., third in direct descent from the famous John Robinson who emigrated from England in the reign of James I, in 1610, to Holland, and was regarded as a leader of the Puritans, and father of the Pilgrims who first landed at Plymouth. His remains rest in the family tomb at Lebanon.

No. 43.—Infant Savior and St. John. Painted in London, 1801.

No. 44.—Portrait of the late Rufus King.—Head, the size of life. Painted in London during his mission, 1800.

No. 45.—Lamderg and Gelchossa. Ossian's Poems, 5th book of Fingal. London, 1809.

"The gloomy heroes fought.—Fierce Ullin fell. Young Lamderg came all pale to the daughter of the generous Tuathal:—'What blood,' she said, 'what blood runs down my warrior's side?' 'It is Ullin's blood,' the chief replied, 'thou fairer than snow: *Gelchossa, let me rest here awhile.*' The mighty Lamderg died. Three days she mourned beside her love:—the hunters found her cold:—they raised this tomb over the three."

No. 46.—Portrait of the late Christopher Gore.—Head, the size of life. Painted in London, during his residence there, as one of the commissioners for the execution of the 7th article of Mr. Jay's treaty, 1800.

No. 47.—Maternal Tenderness. London, 1809.

No. 48.—Our Savior with Little Children. London, 1812.

"And they brought unto him also infants, that he would touch them; but when his disciples saw it, they rebuked them; but Jesus called them unto him, and said, '*Suffer little children to come unto me, and forbid them not, for of such is the kingdom of God.*'"—Luke, xviii, 15, 16.

No. 49.—Peter the Great, at the Capture of Narva. London, 1811.

"Peter, on this occasion, gave an example which ought to have gained him the affection of all his new subjects. He ran every where in person, to put a stop to the pillage and slaughter,—rescued several women out of the clutches of the brutal soldiery, and after having, with his own hand, killed two of those ruffians, who refused to obey his orders, he enters the town-house, whither the citizens had run in crowds for shelter, and laying his sword, yet reeking with blood, upon the table,—'This sword,' said he, 'is not stained with the blood of your fellow-citizens, but with that of my own soldiers, which I have spilt to save your lives.'"—*Voltaire's Life of Peter the Great.*

No. 50.—The Holy Family—The Virgin and Infant Savior, and Joseph the Carpenter—St. John with his Lamb, and Elizabeth his Mother.

No. 51.—Joshua at the Battle of Ai—attended by Death.

"O'er the pale rear tremendous Joshua hung;
Their gloomy knell his voice terrific rung;
From glowing eyeballs flashed his wrath severe—
Grim Death before him hurled his murdering spear."
Conquest of Canaan, by Pres. Dwight, Book 6th, line 643.

No. 52.—The Last Family who Perished in the Deluge.

An infant exhausted by cold, wet, and hunger, lies dead in the lap of its mother, whose whole soul is engrossed, and all her faculties so absorbed in the contemplation of this calamity, that she is insensible to the horrors of the scene which surrounds her, and does not even see that her husband is just dashed from the rock (their last and only place of refuge) by a violent surge, and is perishing at her feet. The father throws up his eyes and hand to heaven, saying—"Heavenly Father! oh, smite us at once with thy lightning, and put an end to this lingering misery!"

No. 53.—"I was in Prison and ye came unto me." Matt. xxv, 36.

Remark.—Some account of the first room may be given at another time. Among the most interesting objects which it contains, are the group by Mr. Augur, of Jephthah and his daughter; and the busts of Homer, Demosthenes, and Cicero, recently presented by Mr. Edward E. Salisbury. Some of the portraits, &c. &c., are worthy of further notice.

Yale College, October 1, 1840.

Art. II.—*On the identity of Edwardsite with Monazite, (Mengite,) and on the Composition of the Missouri Meteorite;* by Charles Upham Shepard, Prof. of Chemistry in the Medical College of South Carolina.

The Journal of the Franklin Institute for May, 1840, contains the following translation from Poggendorff's *Annalen der Physik und Chemie*, No. I, 1840, of an article by Gustavus Rose, on the identity of Edwardsite and Monazite.

"The royal collection at Berlin received a fragment of gneiss from Norwich, in Connecticut, containing a part of a crystal of Edwardsite, which although fractured on either termination, had a sufficient number of planes remaining to determine its angles. Shepard (American Journal of Science and Arts, xxxii, 162) correctly referred this mineral to the oblique-rhombic system, and added that the prism was terminated by a four-sided pyramid. He observed that the cleavage was sometimes perfect, but generally uneven parallel to the oblique terminal plane, but very perfect parallel to the longer diagonal. He further remarks that it bore the closest resemblance to zircon, which the Monazite was supposed to be by *Menge*, who first found it in the Ilmen branch of the Uralian chain. The few measurements of Edwardsite nearly correspond with those of Monazite, excepting the inclination of an oblique terminal plane to the plane replacing the obtuse lateral edge, which, with Monazite, gave an angle of 100° 3′, with Edwardsite 103° 58′, but the calculation of the former was grounded on imperfect measurements. In regard to form, therefore, the two minerals correspond.

"They also resemble each other in relation to other properties. Color, hyacinth red to reddish brown, the lustre of Edwardsite somewhat stronger; hardness = 5 (apatite). Specific gravity of Edwardsite is rated too low by Shepard = 4.2 to 4.6,—that of Monazite, according to Breithaupt = 4.992 to 5.079. In behavior before the blowpipe alone, or with fluxes, both alike, both infusible. Shepard observes that the former fuses with great difficulty on the edges, but no such fusion was observable on the specimen in the royal cabinet. There are some differences in their behavior with acids, the former, according to Shepard, being slightly affected by aqua regia, the Monazite, according to Kersten being decomposed by chlorohydric acid with the evolution of chlorine.

"The apparent differences of their chemical composition may be reconciled. The Monázite was analyzed by Kersten, the Edwardsite by Shepard.

Monazite.		*Edwardsite.*	
Peroxide of cerium,	26.00	Peroxide of cerium,	56.53
Oxide of lanthanium,	23.40	Zirconia,	7.77
Thorina,	17.95	Alumina,	4.44
Peroxide of tin,	2.10	Silica,	3.23
Protoxide of manganese,	1.86	Protoxide of iron, Glucina, Magnesia,	traces.
Lime,	1.68	Phosphoric acid,	26.66
Titanic acid, Potassa,	traces.		
Phosphoric acid,	28.50		
	98.49*		98.73

* There is evidently some error in the figures of this analysis, for the sum of those given is 101.49.

"The chief differences then are that Monazite contains both oxide of cerium and lanthanium, the Edwardsite only peroxide of cerium, (Shepard gives protoxide,) that the former contains thorina, the latter zirconia. Lanthanium is probably contained in Edwardsite, as it generally accompanies cerium, having been first discovered during the past year by Mosander, (was unknown to Shepard.) In regard to thorina and zirconia, it can hardly be assumed that the given quantities are correct, since we have no accurate method of separating them from oxide of cerium; it is nevertheless, worthy of notice that 7.77 zirconia are a nearly full equivalent for 17.95 thorina, for the former contains 2.04, the thorina 2.12 oxygen. It might, therefore, be supposed that the thorina is replaced by zirconia in Edwardsite, which, however, cannot be assumed from the present view of their atomic composition, since, according to Berzelius, thorina is expressed by Th + 0, zirconia by 2 Zr + 30. The tin in Monazite is evidently accidental from its minuteness; but remarkably enough, as Rose remarks, he found it also in Edwardsite, by means of the blowpipe. If the presence of zirconia in Edwardsite be confirmed, and its isomorphy with thorina, then these two minerals can only be separated as species; if not, then both will probably agree in their chemical composition; in which case, it will be more proper to retain the name Monazite, which it first received."

It is proper in the first place to observe that Monazite is the same mineral as that described by Mr. H. J. Brooke under the name of Mengite in the Philosophical Magazine and Annals for Sept. 1831, (p. 189.) Having received from this gentleman a good crystal of the Uralian mineral, and being very forcibly struck by the considerations presented in the foregoing paper, I instantly set about such an examination of the Edwardsite as the nature of the case solicited at my hands.

Their identity in crystalline form appears to be nearly complete. Brooke gives M on M 95° 30′, and I find the crystals of Edwardsite to measure from 95° to 95° 30′. Again his angle between the base (P) and the prism (M) corresponds exactly with mine, as given in my first paper on the Edwardsite. (See this Journal, Vol. xxxii, p. 162.) Being unwilling to fracture my crystal of Monazite to learn its cleavages, I can only add on this head that lines, or rifts of diagonal cleavage are very conspicuous in it, in exact accordance with those which are so striking in the American mineral.

The discrepancy in specific gravity between the two minerals disappears on subjecting larger crystals of Edwardsite to examination. I obtained on a fragment weighing 2½ grs. the specific gravity of 5.00; whereas the Monazite crystal, whose weight is 3 grs. equals only 4.61. It will no doubt be a difficult point to establish an exact agreement between the two, since the specimens to be examined are not only exceedingly minute, but much entangled with other substances, as mica, tin ore, æschenite, &c.

After proceeding thus far in the examination, I felt but little hesitation in concluding that the analogy would be found to hold still further, and extend to an identity in chemical composition; the more so, as I distinctly remembered several ambiguous and nearly irreconcilable circumstances in my analysis of Edwardsite.

All the Edwardsite I could collect by breaking up numerous specimens of the rock amounted to but 5.1 grains. In examining each fragment in order to separate foreign matters prior to pulverization, I detected one very perfect crystal of zircon, (of the form *binotriunitaire*, fig. 495 of my Treatise,) which taken with the fact that they have frequently been observed in proximity to the Edwardsite, leads me to attribute in part the zirconia of my former analysis to this source.

My present object was not so much to determine the number and proportions of the ingredients as to ascertain whether the oxide of lanthanium and thorina are constituents of the mineral. It was heated to whiteness for half an hour, with twice its weight of anhydrous carbonate of soda. The mixture fused into a hard, yellowish gray compact mass, which was treated with boiling water and the insoluble part separated on the filter.

The alkaline fluid was supersaturated with acetic acid, and precipitated by acetate of lead. The phosphate of lead was ignited and weighed 7.5 grs., which is equivalent to 1.38 grs. phosphoric acid, or 27.04 per cent.

The insoluble matter from the aqueous solution of the calcined mineral was now treated with nitro-hydrochloric acid, and digested for several hours. The insoluble portion was separated, ignited and weighed. It amounted to 2 grs. Its color was reddish brown. Believing it still to contain oxide of cerium, I subjected it to a new calcination with carbonate of soda, in order to its more complete decomposition. It had the desired effect; for after the digestion of the calcined mass afresh in *aqua regia* for two hours, the insoluble matter was reduced to 1 gr. which still retained, however, a pale tinge of red, evincing that it was not wholly deprived of the oxide of cerium, or lanthanium, or of both.

This powder was now treated with concentrated sulphuric acid, diluted with its weight of water. A solution was effected with some difficulty, requiring for its completion a digestion of at least two hours. Nothing remained behind, save a feeble trace of titanic acid. The color of the fluid was yellow.

It exhibited the following properties: ammonia threw down a white hydrate, which absorbed carbonic acid from the air, and was readily soluble again in hydrochloric acid, with effervescence. The hydrate is almost wholly soluble in carbonate of ammonia. Ferro-cyanide of potassium threw down a precipitate when added to the neutral sulphate, which it does not do in the case of zirconia alone. From these facts, I think it safe to infer, that the solution in question contained, principally, thorina.

The nitro-hydrochloric solutions of cerium above mentioned, were mingled and precipitated by ammonia. The precipitate was dissolved in nitric acid, and the solution evaporated to dryness. It assumed a rose red, and had a decided astringent, but metallic taste. A solution of hydrochlorate of ammonia was added, and on the application of heat, the insoluble oxide was dissolved with the evolution of ammoniacal gas. I feel fully authorized, therefore, to announce the existence of the oxide of lanthanium in the Edwardsite; but as to the ratio which it bears to the oxide of cerium, I was unable to determine any thing satisfactorily.

Whenever I am able to procure a sufficient quantity of the mineral, I shall renew the research into its composition; but in the mean time I am sufficiently satisfied of its relationship to Mengite to withdraw the claim I at first advanced to its distinct specific character.

By the above investigation, new elements are added to those already known in the State of Connecticut. Mr. Rose detected tin also by the blowpipe in Edwardsite. I may add that I have the same metal from two other places in the state, an account of which, together with a notice of selenium which accompanies the tin at one of its deposits, I reserve for a future occasion. The list of our elements has therefore been augmented to the number of four, within a short period of time.

I detect the Edwardsite in a solitary crystal at the original locality of Sillimanite, in the town of Chester, upon the Connecticut river; but it does not appear probable that this will prove so abundant a source of the mineral as the deposit at Norwich.

Analysis of Meteoric Stone, which fell near Little Piney, Missouri, Feb. 13, 1839.

This specimen was obtained by Mr. Forrest Shepherd, and described by Mr. E. C. Herrick, in this Journal, Vol. xxxvii, p. 385. Mr. Shepherd kindly placed the mass at my disposal, which enables me to extend the account already published by the following notice.

On first inspection, the stone appears rather compact and close grained; it is nevertheless composed for about one half of small imperfectly defined globules of the mineral which has been called meteoric olivine. In color, they are light gray, inclining to pearl-gray, and when freshly broken across, show tints of yellow and green. The remaining stony ingredient is white and semi-decomposed, resembling the feldspathic mineral in certain trachytic lavas.

Through the whole is sprinkled meteoric iron in little shining points, which are often invested with a coating of magnetic iron pyrites. By the aid of a glass, a few little black points were discovered of a mineral which appeared to be chrome-iron ore.

Notwithstanding the apparent firmness of the mass, arising out of its close-grained structure, it is still possessed of but little cohesion, since a slight strain of the fingers is sufficient to produce a fracture, even in a rounded shaped fragment of the stone. When broken up in this manner, however, the pieces are not prone to separate still farther, so as easily to give rise to a powder.

The meteoric iron is not tarnished by exposure to the air. It was examined for chlorine, without affording any traces of this element. The most striking peculiarity found in this stone, was the small proportion of nickel. At first I failed to detect it altogether, but on a repetition of the search with eight grains of the alloy, whose nitro-hydrochloric solution in a concentrated form was decomposed by ammonia in excess, I noticed an exceedingly faint blue tinge in the fluid. The chromium, however, is more abundant than usual, amounting to above 3 p. c. I did not search for tin or manganese.

The following is a summary of the results obtained.

Silicic acid,	31.37	Earthy portion.
Magnesia,	25.88	
Protoxide of iron,	17.25	
Alumina,	.49	
Soda,	traces.	
Iron,	16.	Meteoric iron.
Cobalt, Chromium,	4.28	
Nickel,	traces.	
Sulphur, (phosphorus ?) and loss,	4.73	
	100.00	

Art. III.—*Characteristics of the Language of Ghagh or Accra*; by Prof. J. W. Gibbs.

The following account of the language of Ghagh, is taken from Augustus William Hanson, a native of that country, aged twenty five, son of the British governor at Accra, his mother being the daughter of Osai Kwami, (King Kwami,) the late king of the Ashantis. The Ghagh is his native language, although not that of either of his parents.

The country of Ghagh or Accra is a small district on the Gold Coast in Africa. It is called *Ghagh* by the natives, who style themselves *Ghagh me-i*, i. e. Ghagh people, and *Engkraing* by the neighboring Fantis, from which name the Europeans have formed *Accra*. The Ghagh people are bounded on the north by the Agunas and Akwapims, on the east by the Adampis, on the south by the Gulf of Guinea, and on the west by the Fantis. Within their territory are three European settlements, viz. the English at James' fort, the Dutch at *Creve-cœur*, and the Danish at Christiansburg. The population of these towns, which nearly adjoin each other, is together about fourteen thousand; that of the whole territory about forty thousand. The Ghagh people are a distinct race, and differ entirely as to language from the tribes by which they are immediately surrounded, with the exception of the Adampis. According to their own tradition they came originally from Popo, a district to the eastward of Adampi. The inhabitants of Little Popo, as well as of Great Popo, speak the same language with the people of Ghagh. The people of Popo call themselves *Tawn Bi*, i. e. Tawn people.

I. *Phonology.*

1. This language has the usual vowels, *a, e, i, o, u;* the imperfect diphthongs commencing with *i* and *u*; also the more perfect diphthongs *ai* (Eng. *i*,) *aw* (between Eng. *aw* and *o*,) *oi*, no *au*.

2. It has the simple aspirate *h*, the semi-vowels *w* and *y*, the liquids *n, m, ng*; the sibilants *s, sh*, no *z*, nor *zh*.

3. It has the palatal mutes, *k, g, gh*, no *kh*; the lingual mutes *t, d*, no *th*, nor *dh*; the labial mutes *p, b, ph*, no *v*.

4. It has also *tsh*, (Eng. *ch* in *cheese*,) and *dzh*, (Eng. *j* in *James*.)

5. Besides these sounds, they have the following, which are peculiar to themselves;

(1.) A sort of palatal labial which may be represented by *kp*; as, *kpûngkpagh*, a barrel; *kplashi*, pleasure.

(2.) Another palatal labial, which may be represented by *gb*; as, *gbweh*, a dog; *gberkeng*, a child.

6. But the nasal *ng*, which they pronounce very soft, pervades the language, being sometimes found three or four times in the same word, and gives it a very peculiar character.

II. *Euphony.*

Words ending with *ng*, before a suffix commencing with *m*, change *ng* into *m*; as, *eding*, black, *dimmo*, blackness; *eyeng*, white, *yemmo*, whiteness.

III. *Parts of Speech.*

1. There is a definite article for all genders and numbers, viz. *leh*, resembling the masculine French article. There is no indefinite article.

2. The personal pronouns are

mi, I, me.	*waw*, we, us.
bo or *o*, thou, thee.	*gni-e*, ye, you.
leh or *eh*, he, she, it, him, her, it.	*amme*, they, them.

3. These pronouns placed before a noun form possessives; as, *toyi*, ears; *mi toyi*, my ears; *o toyi*, thy ears; *eh toi*, his ears; *waw toyi*, our ears; *gni-e toyi*, your ears; *amme toyi*, their ears.

4. The pronominal forms, where, whither, and whence, are not distinguished, except by the context; as, *bi-er*, hence, here, hither; *dzhe-i*, thence, there, thither; *nergbwer*, whence, where, whither.

5. There is a substantive verb; viz. pres. *dzhi*, is; past, *yeh*, was. Thus *mi dzhi*, I am; *mi yeh*, I was; *o dzhi*, thou art; *o yeh*, thou wast; etc.

6. The interjection of grief is *ah* or *oh*.

IV. *Derivation of Words.*

Abstract nouns are formed from adjectives by adding *leh*, *li*, *mli*, or *mo*; as,

hewa, strong; *hewaleh*, strength.
tetrer, broad; *tetrermli*, breadth.
kwaw, high; *kwawli*, height.
eding, black; *dimmo*, blackness.
eyeng, white; *yemmo*, whiteness.
etshru, red; *tshuleh*, redness.

V. *Composition.*

In unwritten languages, it is very difficult to distinguish compound words from the combination of words in phrases.

VI. *Inflection.*

1. There is no inflection to express *gender*, that is, to distinguish between the sexes, or between animate and inanimate objects. Sex is uniformly expressed both in men and animals by adding the words *nûng*, male, and *yio*, female; as, *gbawmó yio*, a woman; *dzhattá yio*, a lioness.

2. *Number* is expressed both in substantives and adjectives in three ways:

(1.) Some nouns add *e* for the plural; as, *gbawmó*, a man; plur. *gbawme*, men.

(2.) Some nouns add *i* for the plural; as, *fai*, a hat; plur. *fai-i*, hats; *gbwe*, a dog; plur. *gbwe-i*, dogs.

(3.) Some nouns add *dzhi* for the plural; as, *shiflong*, a dog; plur. *shifong-dzhi*, dogs.

3. *Cases*, or the relations of nouns, are expressed partly by prepositions, partly by the termination of nouns, and partly by the collocation.

(1.) The nominative case is known by its collocation before the verb.

(2.) The accusative case is known by its collocation after the verb.

(3.) The local case is expressed by the termination *eng* or *mli;* as, *gbawmó*, a man; *gbawmomli*, in a man.

(4.) An oblique adverbial case is expressed by the termination *heh* or *gnaw* indifferently.

(5.) The genitive or adnominal case is expressed merely by placing a substantive before another substantive; as, *gbawmó fai*, man hat, i. e. a man's hat; *mi toyí*, I ears, i. e. my ears; *gbawmó fai-i*, a man's hats; *gbawme a fai-i*, men's hats.

(6.) The declension of the noun then is as follows:

SING.	Nomin.	*gbawmó*, a man.	
	Accus.	*gbawmó*, a man.	
	Dative and Ablat.	*gbawmohéh* and *gbawmognáw*,	to or from a man.
	Local	*gbaumoeng* or *gbawmomli*,	in a man.
PLUR.	Nomin.	*gbawmé*, men.	
	Accus.	*gbawmé*, men.	
	Dative and Ablat.	*gbawmeaheh* and *gbawmeagnaw*,	to or from men.
	Local	*gbawmeamli*, in men.	

4. The *comparison* of adjectives is expressed by a periphrasis. The comparative is formed by adding *feh*, more; and the superlative by adding *fehféng*, more than all. Thus,

effong, bad,
effongféh, more bad,
effongfehféng, most bad.

5. *Person* in verbs is expressed by merely prefixing the pronouns; as,

mi súmo, I love;
o súmo, thou lovest;
eh súmo, he, she, or it loves;
waw mi súmo, we love;
gni-e mi súmo, ye love;
amme mi súmo, they love.

The force of *mi* in the plural I am unable to explain.

6. The *tenses* of verbs are expressed by varying the accent, or by auxiliary particles.

(1.) The present tense is accented thus: *mi súmo*, I love.

(2.) The imperfect is expressed by varying the accent; as, *mi sumó*, I loved or did love.

(3.) The perfect again by varying the accent; as, *mí sumo*, I have loved.

(4.) The pluperfect, by the particle *nah;* as, *mi nah mí sumo*, I had loved, liter. I have I loved; *o nah ó sumo*, thou hast loved; etc. Compare *mi nah ni*, I have wealth.

(5.) The future is expressed by a periphrasis; as, *mi ba sumó*, I come to love, i. e. I am about to love.

7. There are no *voices* in Ghagh. The passive is expressed actively; as, *a súmo mi*, some one loves me, i. e. I am loved; *a keh*, some one says, i. e. it is said, French, *on dit.*

8. There are no *modes* in Ghagh;

(1.) The subjunctive or conditional is expressed by means of a conjunction; as, *mi súmo*, I love; *kedzhdzhi mi súmo*, if I love.

(2.) The potential is expressed by a periphrasis; as, *m'agnie akeh mi súmo*, I am able and I love, i. e. I can love.

(3.) The imperative of prohibition is expressed by prefixing *ka;* as, *ka súmo*, love not. The imperative of command is *súmo*, love thou.

(4.) The infinitive is *súmo*, to love.

(5.) The present participle is formed by adding *mo*; as, *sumomó*, loving.

VII. *Syntax.*

1. *Concord.* The only concords are those of the adjective with its substantive in number, and in a compound sentence of the relative with its antecedent in number; as, *gbawmó kpakpa*, a good man; plur. *gbawmé kpakpa-i*, good men.

2. *Government.* Nothing peculiar.

3. *Collocation of Words.*

(1.) The subject of the proposition is placed first, then the verb, then the object, as in English. Thus *gnung-maw hing*, God is good; *gnung-maw mi súmo gbawmé*, God loves men; *gbawmé mi súmo gnung-maw*, men love God.

(2.) The adjective is placed after the substantive which it qualifies; as, *gnung-maw dzhungrong*, God good, i. e. the good God. So the article; as, *gbawmó leh*, the man; *gbawmó dzhungrong leh*, the good man.

(3.) Modifying circumstances are placed after the verb which they modify ; as, *gnung-maw hi-gnaw gnungmawng*, God lives in heaven.

4. *Idiom.* The words for *heaven* and *face* combined signify the *sky ;* as, *gnung-maw hiĕh*, heaven face, i. e. the sky ; *mi dzheh Africa mi ba maigneng*, I came from Africa, I came into this country ; *mi keh klante gbwhe*, I and a sword killed, i. e. I killed with a sword.

VIII. *Versification.*

There is no poetry in this language. The natives, however, compose songs in the Ashanti dialect of the Otsh-wi language.

IX. *Orthography.*

This language has never been reduced to writing for the use of the natives, except partially by the Danes. Should such a reduction ever take place, it is hoped that the general principles may be followed which have been laid down by Dr. John Pickering for the unwritten languages of America, and which have been adopted in this article.

X. *Literature.*

This language possesses no literature. Nor have the natives of Ghagh any knowledge of writing, except so far as an Ashanti convert to Mohammedanism occasionally appears among them, or some of the children are taught in the English or Danish schools.

XI. *Vocabulary of Ghagh Words.*

One	eko or ekome	Eye	hing-mwei
Two	eniaw	Nose	gugong
Three	eteng	Mouth	na-bu
Four	edzhwe	Lip	na
Five	enumaw	Tooth	gnia-gnong
Six	ekpwa	Tongue	li-le-i
Seven	kpwa-wo	Hand	nine
Eight	kpwa-gniaw	Foot	nane
Nine	ne-hu	Back	koto-ser
Ten	gnung-ma	Beard	tshe-i
Twenty	gnung-ma-eniaw	Bone	wu
Thirty	gnung-ma-eteng	Chin	tshe-i
Forty	gnung-ma-edzhwe	Knee	na-ku-tsho
Hundred	oha	Neck	ku-er
Head	i-tsho	Quill	tshi-rer
Hair	i-tshaw-i	Shoulder	kawng
Ear	toi	Soul	gbwaw-mo

Tail	le-i	Door	shi-na
Thigh	shwi-aw	House-door	tshung-shi-na
Upper arm	ni-ne	Drum	mileng
Sun	hu-lu	Egg	wlaw
Moon	niong-tshi-re	Food	gmwa
Heaven	gnung-mawng	Frock	fra-ka
Fire	la	Land	shi-pong
Water	nu	Language	wi-e-mong
Beast	ko-lo	Place	gbwe-he
Cat	a-lam-te	Rice	o-mong
Cricket	kri-li	Grain of rice	o-mong-ku-li
Fly	a-di-dong	Ring	ga or pe-ti-a
Frog	kawkaw-de-ne	Road	gbwe
Kite	lar-law	Stick	tsho
Rat	o-bi-shi	Thanks	shing-da
Snake	o-nu-fung	Thing	gnong
Turtle	ha-la	Tree	tsho
God	gnung-maw	Son	bi-nung
Man (genus)	gbwaw-mo	Daughter	bi-yio
Man	nung	Alive	heng-ka
Woman	yio	Every	fe-er
Child	bi	Red	e-tshu-ru
Father	tsher or a-ta	To ask	bi
Mother	gni-er or a-o	To ask pardon	kpwa-fa-i, lit. to take off the hat
King	mang-tsher		
Slave	gni-ong	To build	mar or tshwa
Name	gbwe-i	To carry	te-re
People	gbwaw-me-i	To catch	mong
Village	a-kro-wa	To cut	fo
Town	mang	To dance	dzho
Country	mang or dzhe	To die	gbwo
Good	e-dzhung-rong or ekpakpa	To do	fe-i
		To forgive	ghor-ke
Bad	e-sha or e-fawng	To get or have	nah
Big	e-wu-lu	To give	ha
Little	fio or bibio	To keep	to
Old	e-mo-mo	To know	le
New	e-he	To land	kpwle-ke-shing
White	e-yeng	To live	ta-shing or yi-aw
Black	e-ding		
Strong	he-wa	To look after	ta-o
Sick	he-mi-ye	To make	fe-i
Arrow	ghang-li	To plant	dung
Bag	ko-to-ku	To play	shwer
Basket	flaw-taw	To put	wa-o
Bell	gmwler	To put on	bu
Boat	bong-to	To remember	ka-i
Bow	ghah-li-tsho	To run	dzho-fu-e
Clothes	a-ta-le	To rest	dzhaw-he
Club	tsho-kpo-ti	To say	ke-er
Comb	o-si-rer	To see	na

To shine	kpwer	All of them	am-me-fe-er
To speak	wi-e	Every thing	ni-fe-er
To strike	tshwa	Forever	da or da-da
To take	kaw	He is dead	eh gbwo
To thank	da-shing	He is not dead	eh gbwo ko
To think	su-su	He is alive	eh hi-eh kang
To walk	gni-er	This is good to me	en-ne hing ham
O	oh or e-bo	This is not good to me	en-ne e-hi-i ha-am
Ah	ah		

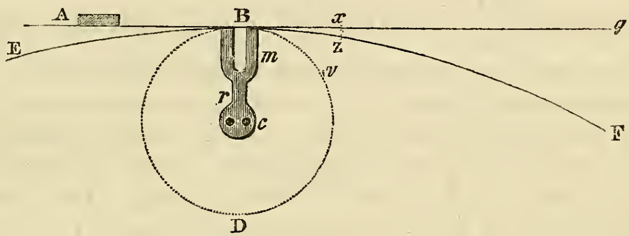
Art. IV.—*Remarks on the Central Forces of bodies revolving about fixed axes*; by Joseph Martin, M. D.

The theory of curvilinear motion may justly be considered one of the most important and interesting subjects connected with the physical sciences. It explains the motions of the heavenly bodies, and, by unfolding some of the grand phenomena of nature, makes them applicable to the most important and useful purposes of life. It has accordingly engaged the attention of the greatest philosophers for centuries, who have, by means of the most searching analyses, not only pointed out the slightest irregularities of those bodies which compose the great planetary system, but have discovered the causes of the seeming aberrations, and given satisfactory explanations of them. And yet it would seem that the most simple case of "central forces," the rotation of a heavy body about a fixed axis, has been in some measure neglected, or at least, treated as a subject of too little importance, either in a theoretical or practical point of view, to deserve more than a passing notice.

To explain the motions of the heavenly bodies it has been found necessary, by means of mathematical reasoning, to determine the ratio of attraction and original impulse, or projectile force, and to show the effects of their separate and combined operation. In this way the part that each of the three forces, the projectile and the central, perform in producing and preserving the motion of a planet in its orbit, is clearly defined; as well as the results that would follow if either of the last should cease to act. But the ratio of the forces which act upon a body made to revolve about a fixed axis, and the nature and extent of their separate or combined action, have not been distinctly shown. In other words, it is believed that the relative proportions of the moving power, and the forces that it produces directly and indirectly—the manner in which the central forces are excited—and the combined operation of all the forces upon a body whilst revolving and when projected, have not been satisfactorily explained.

It is not intended, however, at present to enter into an investigation of the subject upon principles purely dynamical, but the object of these remarks is to show by mathematical reasoning, founded upon experiment and familiar examples, that the power employed to revolve a body about a fixed axis is wholly expended in giving velocity to that body in the direction of the circle, and that, consequently, the central forces must be excited in obedience to a law of nature; and, in the second place, that the moving and excited forces act in conformity with the principles of "the composition of forces."

Fig. 1.



If the bar of soft iron *m*, Fig. 1, be prepared as a horse-shoe magnet and secured in a proper manner to the rod *r*, working horizontally on an axle at *c*, it may be connected at pleasure with a galvanic battery, by means of its wires and the usual arrangements of cups containing quicksilver at the centre. The iron bar A, of a suitable size and description, moving with a given uniform velocity along the straight line A*g*, would be attracted at B by the magnet, if it were connected at that moment with the galvanic battery, and would be made to move in the curve B*v* of the circle BD, but in virtue of its inertia it would, in the absence of friction and atmospheric resistance, continue to move in that circle with the same uniform velocity. For the deflecting force being independent of the projectile force, and acting at all times in the direction of the radii of the circle, it cannot in any respect increase nor diminish the original velocity of the bar. And for the same reasons the force with which the bar is moving in the circle can have no influence upon the deflecting force. But a body moving in a curve or circle is always found to be acted upon by a third force, which is opposite and equal to the deflecting or centripetal force; and as there cannot be an effect without a cause, this third force must either be derived from one of those mentioned above, or their resultant—or from some other source. Supposing the circle BD, in which the bar moves, to be one foot in diameter and the velocity of the bar to be 25.14 feet per second, or at the rate of eight entire revolutions in a second, its centrifugal velocity would be $=\frac{v^2}{2r}=\frac{25.14^2}{1}=632$ feet per second, and its centrifugal force $=39$ lbs. its weight being one pound, v representing the velocity in the circle, and r its radius; for if a be the weight of the bar, g equal to $32\frac{1}{12}$ feet, and x the force required, then $r : \frac{v^2}{g} :: a : \frac{v^2 a}{gr}=x=\frac{25.14^2}{16}=39$ lbs.* But the force in the circle $=\frac{25.14}{16}=1.55$ lbs. only, consequently the centrifugal force could not have been caused by the projectile force. And it is evident that it cannot be a part of the magnetic force, for it acts in a directly opposite direction; and it is equally evident that it cannot be the resultant of the other two forces, for then its direction would be to some point within the circle. The pressure from the centre of thirty-nine pounds must therefore have originated in some other way.

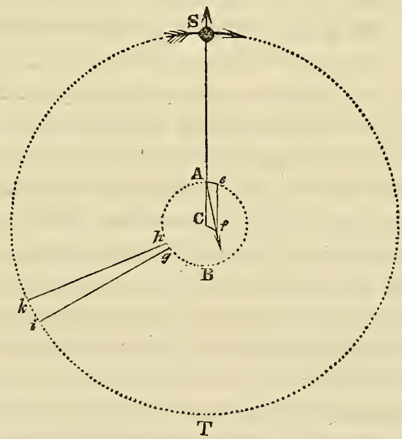
Such are the facts when the deflection from a straight line is caused by a centripetal force directed to a fixed centre of rotation, and the projectile or moving force is applied before the body is constrained to move in a circle. We will now stop the revolving rod r, leaving the bar A attached to m, by the magnetic force. If by means of a winch the same number of revolutions in a second be given to the bar that it had in the first experiment, the centripetal or magnetic force will perform the part of cohesion, and the circumstances in every other respect will be the same that would attend such a rotation if the bar were welded to m. Does the moving power, applied in this manner, directly produce the central force or immediately impart it to the moving body? or, in other words, is centrifugal force a part of the force employed to revolve the body? Without attempting to prove the nega-

* Hutton's Mathematical Dictionary, and Gregory's Mechanics.

tive of this question by minute mathematical investigations, which will be avoided as much as possible on this occasion, I will show by a reference to the familiar examples of the common sling and fly-wheel, that in a revolving body centrifugal force, whatever be its source, is much greater than the power necessary to give rotation to that body, and that it cannot therefore be directly caused by the moving power,—and then explain how it may be proved by a simple experiment.

It has been stated above that writers on dynamics have not clearly defined the operation of the laws of curvilinear motion on bodies revolving about fixed axes. One only of the many instances in which erroneous views are given by popular writers in noticing the subject of central forces, will be mentioned. In the Library of Useful Knowledge [London edition] a writer, after enumerating some of the wonderful effects produced by *accumulating force in the circumference* of a fly-wheel, remarks: "the same principle explains the force with which a stone may be projected from a sling. The thong is swung several times round by the force of the arm until a considerable portion of force is accumulated and then it (the stone) is projected with all

Fig. 2.



the collected force.* By observing the facts we may discover how all this accumulation of force is produced by the strength of the arm. A stone, S, Fig. 2, weighing one pound, secured to the end of a string rather less than two feet long, may be whirled in a circle of four feet diameter at the rate of two entire revolutions in

* Vol I, p. 51, Art. Mechanics.

a second. It is done by turning the hand in a small circle AB, about a moving axis of rotation. The velocity in the large circle $=12.57 \times 2 = 25.14$ feet per second; and, as shown above, if S represent the weight of the stone, v its velocity, r the radius of the circle and x the centrifugal velocity, then $r : \frac{v^2}{64} :: S : \frac{v^2 s}{32r} = x = \frac{25.14^2}{32 \times 2} = 9.87$ pounds. The velocity in the circle being 25.14 its force in that direction is equal to 1.58 lbs.;* and if we add 1.42 lb. for the weight of the stone and atmospheric resistance, which is more than sufficient, we have three pounds as the force with which it is impelled in the circle ST. To enable him to move the stone in the circle the operator has to *resist a force nearly equal to ten pounds, which urges his hand from the centre at every instant of time.* He must therefore exert his strength at A in the direction of the resultant of the two forces with an effort which is equal in amount to their mechanical equivalent. If we make Ae and Ac in length proportionate to the forces 3 and 10 respectively, then the diagonal Af of the parallelogram $Aefc$, will show the direction in which he draws at the string, and $\sqrt{10^2+3^2} = 10.44$ lbs. will be the amount of force necessary to give the required velocity; of which, as shown above, two-thirds are expended in retaining the stone in the circle. Now it would be about as easy to show that a man can draw at a flexible cord secured to a stationary object with a force equal to 10 pounds, and at the same time press against that object, *by means of the cord*, with a force equal to six pounds, as to prove that the centrifugal force in this case is the immediate effect of the moving power. The man moves his hand in a small circle and pulls at a stone, nearly in the direction of the string to which it is attached, with a force equal to six times the weight of the stone, and yet, according to the popular belief, he not only imparts directly to it all the force with which it is projected, but dashes it off at right angles to the thong, as if it were moved at the end of a lever.

The thong of the sling, from what is said above, may be considered as in the place of an inflexible rod, the hand resisting the pressure that would act as a strain upon an axle at c; and if such a rod had a handle at A, the same effect might be produced. But it would cause great friction and strain upon the axle, and

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* Cavallo's Philosophy, p. 66.

to obviate those difficulties, we will consider the circle ST as passing through the centre of the rim of a fly-wheel connected by arms with the small circle AB, representing a nave working on an axle at *c*. If the rim be supposed to weigh 150 lbs. it might easily be revolved at the rate of two entire revolutions in a second by a handle at A, which is four inches from the centre, or so considered for illustration. When the winch A is moved about the axis, the force may be considered as acting by repeated slight impulses, as if it were applied at right angles to the radius of the circle, at each instant of time along the side of a polygon with an infinite number of sides, drawn within the circle. If the sides of the polygon be one hundred in number, they would be one fourth of an inch long, and then one and a half inches in the larger circle ST, will be the length of each side of a polygon along which the centre particles of the rim may be supposed to move. As the proportion of the circle ST is to AB as six is to unit, a moving power acting on the latter at the winch A, with a given force, through *g*, *h*, one fourth of an inch, will move the rim through *i*, *k*, equal to six times that space, with one sixth of the force applied; but as *the moment of rotation is equal to force multiplied by leverage*, the whole amount of force upon the rim through that space must be exactly equal to the power applied through the fourth of an inch upon A. And so of each side of the two polygons respectively. But they are considered infinitely small and ultimately become parts of the two circles; the power therefore must be applied in a circle, and the particles of the rim must be propelled in circles with a force exactly equal to that power. Consequently, the moving power, applied to a fly-wheel or to any other revolving body, cannot be expended in pressing the particles of such bodies from the centres nor in the direction of tangents to the circles in which they revolve. And this is evident from the fact, that such moving bodies cannot give out nor impart, in any manner whatever, more force than is applied to revolve them. And *that force is not only equal* to the power applied, but it is always returned in the circle in which the body moves, *and in a direction contrary to that in which it was received.* "If a wheel spinning on its axis with a certain velocity be stopped by a hand *seizing one of the spokes*, the effort which accomplishes this is exactly the same, as, had the wheel been previously at rest, would have put it in motion in the opposite direction with the same velocity."* The force applied to the winch, in the case above, was wholly expended in giving velocity to the rim, with the slight exceptions mentioned. Consequently, whatever other forces may have operated on the rim whilst revolving must have originated in some other way. And yet those extraneous forces would amount to 1480 lbs., as shown by the above formula, the rim weighing 150 lbs. and being revolved at the rate of two entire revolutions in a second. No part of this force could be communicated to the arm of a man who would stop such a wheel by seizing one of the spokes, because *each particle* of the rim is acted upon by the central forces, which are always opposite and equal, in the direction of the radius of the circle *at that point;* and it has just been shown that the moment of rotation of each particle is equal to the moment of rotation of the power that impels it, but "as the direction of the central forces is in that of the radius, their moment of rotation is equal to nothing."† Consequently the centrifugal force cannot act upon the hand that stops the wheel. If, indeed, the centrifugal force were increased to sixteen times the above amount, the result would be the same. By giving the wheel eight revolutions in a second we would have the central force $= 1480 \times 16 = 23680$ lbs. and the force in the circle would be $= \frac{12.57 \times 8 \times 150}{16} = 925$ lbs. Here the centrifugal force is twenty times greater than the force in the circle, and yet as the central force would act in the direction of the radii, its moment of rotation would be $= 0$. Or, what is more strictly the fact, the central force acts by pressure, and a resultant from that pressure and the force in the circle is the consequence, but so long as resistance from cohesion continues, neither motion nor pressure can be imparted to another body by the central force. These are the obvious reasons why no greater force could be communicated by the rim than the 925 lbs., which it only possesses as a mass of matter moving in a circle.

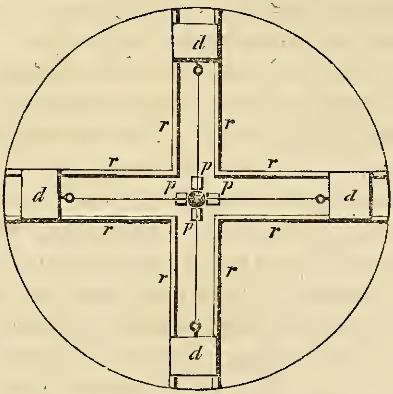
The following experiment may be considered as a practical illustration of the theoretical views given above. A whirling table may be made of any convenient size, we will say, for the present occasion, rather more than four feet in diameter, to revolve horizontally on friction rollers placed near the center; the axle being a hollow cylinder, through which four cords pass to the

* Kater and Lardner on Mechanics, p. 24.

† Renwick's Mathematics, Art. Composition of Forces.

floor to be connected with a tin tube for containing shot or some other weight. The cords are brought over the pulleys *p*, *p*, *p*, *p*, Fig. 3, at the centre, and secured to the dishes *d*, *d*, *d*, *d*, weigh-

Fig. 3.



ing one pound each, and moving, with very little friction, on little wheels adapted to the strips or rails *r*, *r*, *r*, *r*. By connecting this table with wheel-work, having bands or teeth acting on the hollow cylinder as a spindle, by means of a weight or power suspended by a rope wound round an axle, and moving *very slowly*, a certain number of revolutions in a minute will be given to it by the power, in passing through a given space, and the four dishes will raise, by their centrifugal force, a weight in the tube below, proportionate to the velocity and their distance from the centre. If the *moving power be then doubled*, with a slight addition to overcome the additional friction and atmospheric resistance, it will be found, *that in moving through an equal space in the same time*, it will give twice the former velocity, and the dishes, at the same distance from the centre, will raise in the tube below, in an equal time, *quadruple the weight first raised.* Then by loading the dishes and increasing or diminishing the velocity, and varying the distances of the dishes from the centre, a variety of experiments may be made, and weights may be raised, with corresponding distances and velocities proportionate to those given above.

By observing the manner of performing the experiments with the magnetized bar, it will be seen that a centrifugal force is excited, INDEPENDENTLY OF THE PROJECTILE FORCE, equal to the supposed power of the magnet, and we have shown that the same effects would follow without the use of the magnet. And that the impelling or moving power performs no other part in producing the complex effects attendant upon rotation, than simply to move the particles of a mass of matter in circles about a fixed axis, may be clearly shown by the theory of curvilinear motion, which those experiments were designed to illustrate. But without attempting to prove this at present, by abstract mathematical reasoning, the nature of deflection and the extent of its operation in exciting the central forces may be explained by a reference to the action of electro-magnetism as shown in Fig. 1.

The bar A, when attracted by the magnet, being supposed to revolve in a circle of one foot in diameter, at the rate of eight revolutions in a second, or 25.14 feet, to determine the amount of deflection in any unit of time, say one fiftieth of a second, the whole space through which it moves in a second may be divided into fifty parts, which will give six inches for each unit of time. If this space be measured on the tangent from B to x, and on the circumference of the circle to v, the deflection for the one fiftieth of a second would be equal to the square of Bv, divided by BD, or the diameter. For by dynamics, "if a body revolve uniformly in a circle, the space through which it would move by the action of the centripetal force alone in any unit of time, such as a second, will be equal to the square of the arch described in the same unit divided by the diameter or twice the radius."* And the deflection of the bar in the $\frac{1}{50}$ of a second $=\frac{Bv^2}{2Bc}=\frac{6^2}{2r}=3$ inches. That is, the deflection from the tangent Bg during the time that the bar would have passed over six inches in that line, is three inches; and the deflection corresponding with the space Bg, which is equal to two feet, and through which the bar would have passed in the $\frac{4}{50}$ of a second, would be $=\frac{2^2}{2r}=4$ feet, and so of any other space.

Now to show that the amount of this deflection or centrifugal force depends upon the curve in which the bar is moved in a given time, and not upon the moving power, or projectile force, we will cause the same bar, moving with an equal uniform velocity, to be attracted in a similar manner by the magnet m, attach-

* Brewster's New Edinburgh Encyclopedia, Art. Dynamics.

ed to an arm revolving in a circle of eight feet in diameter, and let EF be an arch of that circle, touching the straight line Ag at B. As the velocity of the bar and the circumference of the circle are equal, the bar, after being attracted by the magnet at B, would move on with the same uniform velocity and perform one entire revolution in a second, friction and the resistance of the atmosphere being considered equal to nothing. And its deflection from the straight line, or its centripetal force for $\frac{1}{50}$ of a second, would be equal to the square of the arch Bz, which is six inches, divided by the diameter of the circle, that is $= \frac{6^2}{8} = .375 = \frac{3}{8}$ of an inch, or only one eighth of the deflection caused by the smaller wheel; and in the same ratio for any other spaces through which the bar would have passed whilst moving through equal spaces in the circle. And hence it is that the central forces are inversely as the diameters of the circles in which a body is made to move with a given velocity. The increment of deflection for an entire second being $= \frac{25.14^2}{1} = 632$ feet per second in the smaller wheel, and in the larger one $= \frac{25.14^2}{8} = 79$ feet per second only; and yet the bar has precisely the same velocity, and consequently the same force in the latter that it had in the former. Therefore, aside from friction, it would, if welded to m, require no more force to revolve it in the former than in the latter case.

For the same reasons, with a given velocity for the particles of the rims, the smaller a fly-wheel is, the greater will be the amount of centrifugal force, other things being equal. This will appear obvious upon inspecting the figure; for it will be seen that a particle of iron at v in the rim of a small wheel would be deflected from the straight line eight times as many inches in a given unit of time as a particle would be at the point z of the large wheel. The measure of the deflection from that line must therefore be the measure of the centrifugal force for any instant of time; and consequently the aggregate amount will be proportionate to the curve in which the body moves. This deflection takes place when a body is moved in a curved line, and the tendency to resist it and move in a straight line is excited in such a mass of matter in obedience to the important law of inertia, with as much certainty as electricity would result from the action of sulphuric acid upon two contiguous plates of zinc and copper. *Centrifugal force may therefore with propriety be considered a physical agent, which is called into action, by an inscrutable law of nature, whenever matter is made to move in a curve*;—which ought to be no more a subject of surprise than that magnetic force should be excited in a bar of iron by certain chemical operations, the precise nature of which is as little understood as that of inertia.

The centrifugal principle has been employed as a projectile force from the earliest ages. It would be interesting to notice the extent to which it was used in ancient wars; and particularly to point out, as might be done even with the feeble lights afforded us, how much Archimedes was indebted to the central forces for the destructive effects of his engines, which I believe to have been no fabled nor imaginary productions of genius.

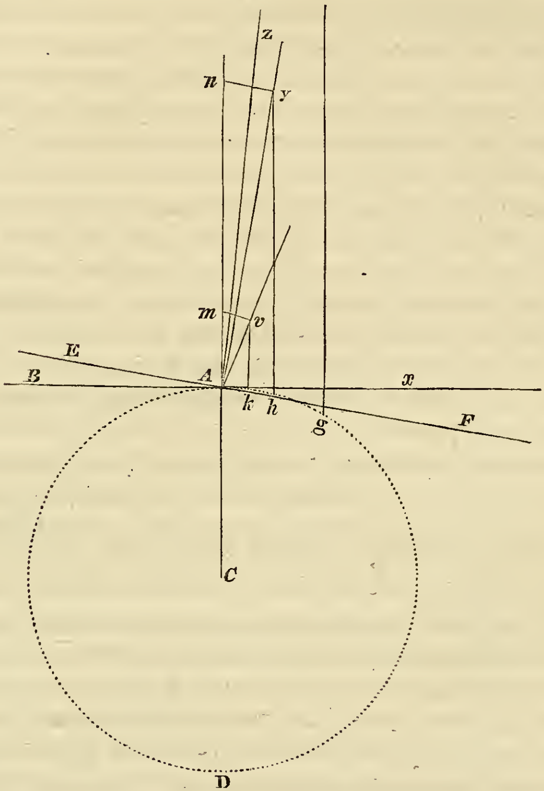
As I shall here come in conflict with some generally received opinions, I will give a short extract from Professor Renwick's Elements of Mechanics. Not that he differs from other writers on this subject, but I find that the extract will be useful in explaining what is to follow. "The simplest case of central force is where a body connected with a fixed point by an inflexible straight line is impelled by a projectile force, at right angles to that line. The latter force would have impressed upon the body a motion with a uniform velocity. The body, then, in consequence of its connection with a fixed point, describes a circle of which that point is the centre. If the connection were to cease at any point in the curve, the deflecting force would cease to act, and the body would go in a straight line whose direction would be a tangent to the curve. The force acting at any point in the curve must therefore be decomposed into two, one of which is in the direction of the curve, the other in that of the radius."*

If a ball at A, Fig. 4, weighing one pound, and attached to an inflexible rod AC, two feet long, be impelled by a projectile force or moving power at the rate of two entire revolutions in a second, or $25\frac{14}{100}$ feet per second, it will have a centrifugal velocity equal to 157.76 feet per second.† Those two velocities then, equivalent to the forces 1.58 lbs. and 9.87 lbs. respectively, constitute the aggregate amount of force acting on the body at any point of the curve or circle; the former acting in the direction of the curve, and the latter in that of the radius—one caused

* Page 62. † Cavallo, p. 66.

by the motion of the particles of matter, the other excited by a cause producing pressure, resisted by cohesion. Now, according to the fundamental principles of mechanics, "the same cause

Fig. 4.



acting upon a body will either produce motion or pressure, according as the body is free or restrained." And, "if two forces act upon the same point of a body in different directions, a single force may be assigned which, acting on that point, will produce the same results as the united effects of the other two." Here we have two forces acting on each particle of the revolving body, but they are resisted by cohesion, therefore when cohesion ceases to act, the effect of the two forces must be, according to the theorem of the composition of forces, to impel it in the direction of their resultant, and with an amount of force equal to their mechanical equivalent;—and experiment shows the correctness of the theory. If an ounce ball of lead, with a small hole drilled through it, be firmly secured by a catgut string close to the perimeter of a fly-wheel, or any other wheel that can be rapidly revolved, it may be discharged from the vertical point of the circumference, whilst the wheel is revolving, by interposing a sharp knife well fixed in a slide. When the velocity necessary to project the ball horizontally at a given short distance has been ascertained, then by increasing the velocity and taking care to discharge the ball from the same point of the circle, and at an equal distance from the centre of the wheel, its elevation will be found to increase with the increased projectile force. And the experiment may be varied by having a number of balls prepared of the same weight, and varying the velocities and the distances from the centre. The effects of gravity, however, and the difficulty of representing by a straight line what may be considered the direction of the circle, have prevented me from determining *geometrically the direction* of the projectile, although in practice it may easily be ascertained.

If the ball be discharged from the point A, with one revolution in a second, its velocity in the circle would be 12.57 feet per second, and its centrifugal velocity would be $=\frac{v^2}{2r}=\frac{12.57^2}{4}=39.44$ feet per second, and the initial projectile velocity would be $=\sqrt{12.57^2+39.44^2}=41.40$ feet per second, disregarding for the present atmospheric resistance. And if, in the way of illustration, AF be considered as the direction of the force in the circle AD, the sides A*k* and A*m*, of the parallelogram A*mvk*, being made proportionate to the two velocities 12.57 and 39.50 respectively, the diagonal A*v* of the parallelogram will represent in direction and proportional amount the velocity 41.45 or initial projectile velocity. If a billiard-ball, moving upon a table with a velocity equal to 12½ feet per second in the direction EF, were to receive at A an impulse in the direction of *cn*, which alone would cause it to move with a velocity equal to 39½ feet per second, no other direction and velocity could be assigned to it than that designated by the diagonal A*v* of the parallelogram. The revolving ball is supposed to move in the direction A*k* with the velocity of 12.57 feet per second, represented by that side of the parallelogram, and at the same time to be acted upon by a force which would cause it to move with a velocity equal to 39½ feet per second, in the direction of the side A*m*, which indicates that velocity, consequently *no other direction nor amount can be assigned to it, when projected, than the diagonal* Av *of the parallelogram* A*mvk*. If the velocity of the ball be doubled, the centrifugal velocity increasing as the square of the increased velocity in the circle, it would be $=39.44\times 4=157.76$ feet per second, and the initial projectile velocity would be $=\sqrt{25.14^2+158^2}=160$ feet per second; and the two first would be represented by the sides A*h* and A*n*, respectively, of the parallelogram A*nyh*, and the diagonal A*y* would indicate the direction and relative proportion of the initial projectile velocity. With four revolutions in a second, the initial projectile velocity would be 635 feet per second, in the direction of the line A*z*. At least such would be the directions for those three velocities *at the instant the ball leaves the point from which it may be discharged.* But with such low velocities a pound ball would not indicate those directions by its path, for the reasons given above. *With very high increasing velocities*, however, the experimenter will find that a small leaden ball will move in directions approaching that of the radius, as shown in the diagram. In repeated experiments made with a machine revolving vertically, and having a tube placed in the direction of a tangent to the circle in which leaden balls were revolved, it was found that with very high velocities they were forced through the tube with difficulty, and a portion of each was removed by the friction, and the upper part of the tube, on the inside, was worn smooth. But with much lower velocities the balls passed through the tube without any apparent friction.

In performing the first experiment, the bar, (A, Fig. 1,) moving with uniform velocity in every part of the circle BD, has the same centrifugal force at *v* that it would have after revolving for a minute or more; for the amount of that force depends upon the curvature and the circular velocity, and consequently was excited to the amount of thirty-nine pounds instantaneously, and if it had been discharged at three inches from B it would have been projected with that force. If this were not the case with bodies moving in space, supposed to be thus deflected, they would fall to the centre of attraction. Now as this is the fact, the *tangent* B*x* in the diagram only serves, as every mathematician knows, to show geometrically *the amount of deflection in a unit of time*, measured at right angles to that line, the space *xv* representing that through which the centripetal force alone, acting uniformly, would cause the body to fall in the fiftieth part of a second; the tangent, therefore, represents THE LINE FROM WHICH *the body would be deflected in an instant of time, and* NOT *that in the direction of which it would move with all its projectile force.*

Again, if the segment of a fly-wheel disintegrated by centrifugal force would be projected "in a straight line, whose direction is that of the tangent," the pressure which produces the fracture must act upon each particle of iron in the direction of a tangent to the circle in which the particle is revolved, for the direction of a moving body is always that in which a single force, or the resultant of two or more forces, acts to cause the motion. And it is self-evident that no amount of force, applied in that direction upon the particles in the revolving rim, could overcome the attraction of cohesion. And it is equally evident that such cannot be the direction in which the pressure acts, for whilst it is stated that the tangent is the direction in which the dissevered fragment is projected, we are informed that the force which causes the fracture acts at right angles to the tangent.

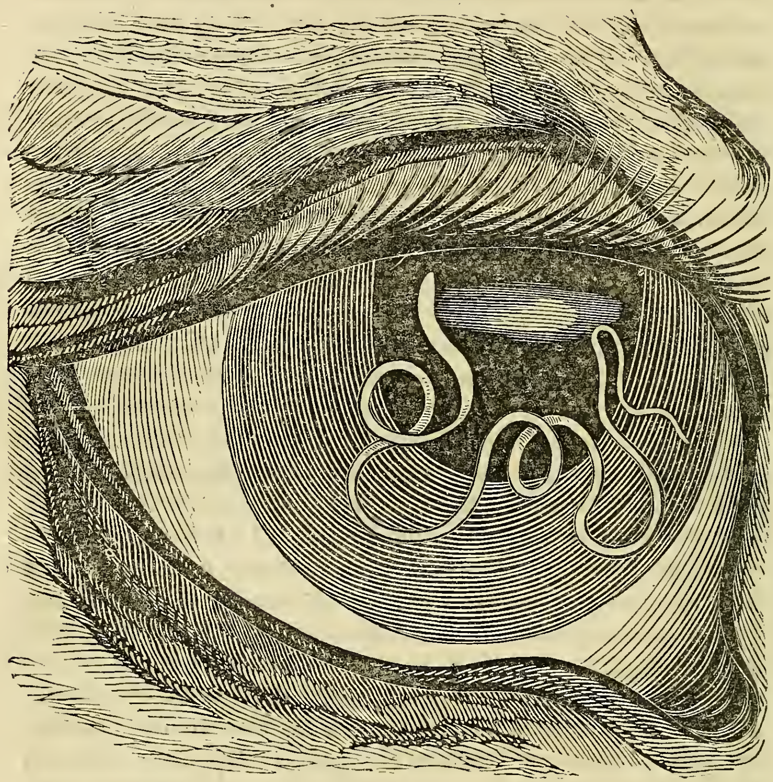
By the theory given above, however, which is founded upon observation and experiment, all the circumstances that attend this phenomenon are easily explained. And when we consider the immense increase of centrifugal force as the velocity of the rim is increased, *and the direction in which the resultant of the two forces acts*, we ought not to be surprised to find that such masses of iron can be broken and projected with so much destructive effect by this powerful agent. The operation of the sling may also, in this way, be explained in a few words. For a man, with a thong three and a half feet long, has only to give to a stone at the final effort a velocity, in a very small segment of a circle, equal to 132 feet per second, which would be at the rate of 360 revolutions in a minute, and he will project it with a force equal to that given to a ball of the same weight by an ordinary charge of gunpowder, after deducting one third of its initial velocity for atmospheric resistance. But to "accumulate" an equal force in the circle by the strength of his arm, he would have to revolve the stone at the rate of 6850 revolutions in a minute, which is impossible.

Without intending to enter into any particulars as to the probable results of a practical application of this principle, I will close with a few remarks designed to show the amount of force excited by the rotation of heavy bodies about fixed axes, and the extent to which we may reasonably conclude it might be employed, if it could be controlled, by giving the relative proportions of the power necessary to revolve a body and the central force excited, considered abstractedly, apart from friction and atmospheric resistance. "The arc which the revolving body describes in a given time is a mean proportional between the radius of the circle and double the space which its centripetal force alone, acting uniformly, would cause it to fall through in the same time."* Consequently the diameter is to the circumference as the circumference is to the space which the centripetal force of the body would make it fall through in the time of one revolution. That space, therefore, is to the circumference as 3.141 is to unit, [3.141 being the circumference of a circle whose diameter is unit,] and the central velocity or force for an entire revolution in a second is equal to the circumference multiplied by 3.141. Hence *the ratio of the central force to the force in the direction of the circle, or the moving power, is as the product of the number of revolutions in a second by* 3.141 *is to unit.* That is, if there be two entire revolutions in a second, whatever be the weight of the body or its distance from the centre, the ratio of the centrifugal force to the moving power would be as 3.141×2 is to unit, or as six to one, nearly; and with eight revolutions in a second the ratio is as 3.141×8 to unit, or as twenty-five to one. And since "the velocity of rotation is almost unlimited,"† if a fly-wheel, similar to the one described above, were revolved at the rate of twelve hundred revolutions in a minute, the excited or centrifugal force in the rim would be equal to sixty-two and a half times the amount of power employed to give the requisite velocity, some deduction being made for friction and atmospheric resistance.

* Cavallo's Nat. Philos. p. 66. † Fisher's Nat. Philos.

Art. V.—*An account of a Filaria in a Horse's Eye, with remarks on similar phenomena, and the mode of their origin;* by Charles A. Lee, M. D., of New York.

Read before the Lyceum of Natural History of New York.



The existence of parasitic worms in the interior of animals has been known from a very remote period. They are mentioned by Hippocrates, Galen, Celsus, Pliny and other writers; and various speculations have been advanced in respect to their origin. It is only however within modern times that they have received much attention from physicians and naturalists, except as to their agency in the production of disease. Many different genera and species have now been described by Linnæus, Rudolphi, Bremser, De Blainville, Cruvelhier and others, and arranged according to their several characters. Indeed so numerous have these animals become, that their study constitutes quite an important branch of zoology. Large and important works have been written upon a single species of these parasites, and Dr. Nordmann of Germany has lately published a treatise on those that inhabit the eyes of the higher orders of animals. They may be arranged under two general divisions. 1. The *Entozoa*, or those which reside in the internal parts of the animal, and 2. *Ectozoa*, those which are confined to the external surface. The latter are chiefly *insects*, the former *worms*.

Linnæus arranged the *Entozoa* according to the situation which they occupied: viz. such as are developed in cavities communicating with the external air, as *intestinal worms;* and such as are imbedded in the very *substance* of organs, *visceral worms*. The classification of Rudolphi, however, is founded on the varieties of form, as *Nematoides*, *Acanthocephala*, *Trematoda*, *Cestoides*, *Tænia*, and *Cystica* or *hydatids*. Cuvier divides them into two classes; one characterized by a digestive cavity, and the other by the parenchymatous structure.

A horse is now being exhibited in this city whose right eye contains a vermiform animal, floating in the anterior chamber, between the *iris* and the *cornea*. It was first observed in February last, when it was about half an inch in length; since which time it has increased so as to measure at present about four inches, resembling a portion of white thread or bobbin, with an enlargement at one extremity of half an inch or more in extent. The animal is confined exclusively to the anterior chamber of the eye, in which it swims with the greatest ease and activity; doubling itself in every direction, and performing the most graceful and rapid evolutions. It seems remarkable that it should not penetrate the iris, and visit the posterior chamber. Why it does not, it is impossible for me to explain. Its movements do not appear to excite any sensation in the horse, although a milky cloudiness in the aqueous humor, somewhat dims the vision of the eye in which it floats. This discoloration is believed by Mr. Camp, the owner of the horse, to be owing to the *excreta* of the parasite, which, he says, are evacuated about once in three weeks, when the eye appears much more clouded than at other times. This, however, is observed to subside considerably in the course of a few hours. Whether this be a fact, may well admit of a doubt. We think it more probable that the cloudiness is owing to the ef-fusion of coagulable lymph, the result of inflammation of the vessels, caused by the presence of a foreign body. There is no doubt whatever that the discoloration exists in the aqueous humor, and not in the cornea. A few weeks after the animal was first discovered, the conjunctiva was much injected; but since that time it has assumed its natural, healthy appearance, and now does not differ in the least from that of the other eye. There is nothing peculiar in the appearance of the horse, which is of the Eclipse family, and seven years old. Owing to the incessant and rapid motion of the worm, it is difficult to examine it with a microscope, so as to determine with accuracy, its precise internal organization, yet it evidently belongs to the class *Entozoa*, order *Nematoidea*, genus *Filaria*, species *Papillosa*. The only other genus which it resembles, is the *Gordius* of Linnæus; but as this belongs to the class *Annelides*, which have red blood, inhabit the water only, and are more filiform in shape, there is but little danger of confounding them together.

We have stated that the *Entozoa* are so called because they inhabit the interior of other animals. Every kind of animal, indeed, has been supposed to have its *Entozoa*, or internal parasites, which are peculiar to itself, just as it has its *Ectozoa*, or external ones. They not only infest the alimentary canal, and the ducts leading into it, but also the *muscles*, the *cellular tissue*, and the *parenchymatous structure* of the different organs, as the brain, liver, lungs, kidneys, &c. Indeed, it is now believed by many naturalists, that every different tissue and organ of the body has its peculiar parasite. Thus in man, more than twenty different species of animals have been discovered in different parts of his body. In the *brain*, we find the *Echinococus hominis;* in the *liver*, the *Fasciola hepatica;* in the *venous blood*, the *Linguatula venarum;* in the *kidneys*, the *Strongylus gigas;* in the *muscles*, the *Hydatigera cellulosa;* in the *cellular tissue*, the *Filaria medinensis*, or Guinea worm; in the *female ovaries*, the *Linguatula pinguicola;* in the *intestines*, the *Tænia solium*, the *Ascaris lumbricoides*, &c.; and some attack infants only, as the *Oxyurus vermicularis*.

Mr. Richard Owen, of England, has lately discovered that the human muscles of voluntary motion are sometimes the residence of very minute cysts of an oblong figure, in size and color bearing a strong resemblance to *nits*, or the young of *pediculi*.

These cysts appear, when examined with a lens, not exactly ovoid, but irregularly contracted towards one extremity, so as to form a kind of short neck. These are dispersed throughout the the muscles over the body, and are placed in the direction of the fibres, in the cellular membrane, immediately investing the muscular fibrillæ, or the tendinous fibres to which they are attached. In a recent specimen, one and sometimes two thread-like worms may be seen, coiled up in each cyst. Mr. Owen regards this animal as closely allied to the eels which are found in paste and vinegar, and has given it the name of *Trichina spiralis.* It is very probable that some anomalous diseases may be occasioned by the great multiplication of these worms, while the cause is unsuspected and inexplicable.

The most common worm met with in the different classes of animals, is the *fluke*, or *Fasciola hepatica*, which is sometimes also found in man. We find it in cattle, sheep, swine, and deer; in reptiles, fishes, and even worms of the largest kind; and it is this which occasions the disease called the *rot* in sheep. Leuwenhoeck counted 870 of these animals in one liver. Hydatids are also found in sheep, in the brain and liver, and often carry off whole flocks. This is also met with in man, swine, deer and oxen, of which there are three different species, viz. *cerebralis*, *vervecina*, and *ovilla.* It is unnecessary however to go into detail, in relation to the different species of parasites which inhabit the different races of animals; it must suffice to state, that they are extremely numerous,—that though some are common to several species, yet that, in general, each has its peculiar parasite;—and, moreover, that probably each texture and organ furnishes a habitation for a distinct race of inhabitants. To this it might be added, that many of these parasites have parasites of their own, so that they are literally paid in their own coin.

It has been remarked that the *Filaria* belongs to the order *Nematoidea* of Rudolphi. This order embraces those animals whose external skin is more or less furnished with muscular fibres, and usually striated transversely; containing an abdominal cavity, in which is a distinct intestinal canal, extending nearly the whole length of the body. The intestine is connected with the neighboring parts and the general envelope of the body by numerous threads, considered by some writers as vessels for the conveyance of the nutritious fluid, and by others as *tracheæ*, but without sufficient proof of the fact. We can discover no true circulation in these animals, but in several there appear to be one or two nervous cords, which surround the mouth, and extend the whole length of the body along the internal surface of the envelope. The intestine is for the most part straight and of considerable width; the esophagus is contracted, and in some species the stomach is distinctly developed. The animal is of both sexes and propagates by *ova*, which are extremely small.

The *Filaria* is of a long, slender, filiform shape, and perforated at the anterior extremity by a round oval aperture. Some species bear considerable resemblance to the *Gordius*, or hair-snake, which abounds in fresh-water brooks and ponds. It principally occurs within cavities which do not communicate externally,—in the cellular membrane, the substance of the muscles, and different viscera, and occasionally in the eye. The following embrace a few of the more common species.

1. *Filaria medinensis*, or Guinea worm, is the most common and best known species. It is found chiefly in warm climates, where it is often seen in the morning dew, sometimes ten or twelve feet long, and not thicker than a horse-hair. It is this species which insinuates itself under the skin, where it may be felt like a tense string. Here it burrows and grows to a length of several feet, without exciting great pain or uneasiness, until the skin is perforated by the animal. It is usually drawn out with great caution, by means of a piece of silk tied around its head. If it break by a too violent effort, the part remaining grows with redoubled vigor, and often occasions a fatal inflammation. When drawn out, it is found to be elastic, white, transparent, and contains a gelatinous substance. Though usually met with in the lower extremities, it sometimes occurs in the integuments of the head, neck and trunk, and Baron states that he saw two instances of it under the mucous membrane of the eyeball.

2. *Filaria bronchialis.* This species is described by Treutler, and so named from its occurrence in the lungs of persons laboring under phthisis. It has also been called *Hamularia lymphatica*, and by Rudolphi, *Haularia sub-compressa.* This is also met with in the lungs of the inferior animals, especially when affected with tubercles. Dr. Hodgkin states that he often found the Filaria in the lungs of the *boa constrictor.*

3. *Filaria gracilis* is found in apes and monkeys in great abundance. It grows to a length of ten or twelve inches, is about as thick as a fine thread, head obtuse, and tapering slightly at both extremities.

4. *Filaria attenuata.* This species is found in the abdominal cavity of crows, also in the cornea of the eye of fishes. It is from one to six inches long, and obtuse at both extremities.

5. *Filaria obtusa* inhabits the intestines of swallows. Its head is somewhat acute, tail obtuse, body comparatively thick and elastic, and has been found twelve inches in length. M. Rudolphi has traced out its intestinal canal and ovaries.

6. *Filaria truncata.* This species is about five inches long, has a truncated head, a tail somewhat thick, obtuse, terminated by a very sharp point; inhabits the *larva*, or caterpillar of certain species of moths. (*Tinea padella.*)

7. *Filaria ovale.* This species formerly went under the name of *Gordius piscium*, (hair-worm of fishes,) because it is found in the liver of the *carp*. It is three or four inches in length; head oval; tapering forwards; tail round.

8. *Filaria capsularia.* From half an inch to an inch long, and resembles in thickness a middle-sized thread. The borders of the mouth are recurved, resembling, according to De Blainville, the mouth of a pudding-bag; tail obtuse, papilliform, and ending with a fine, sharp point. It occurs of both sexes, with a large intestinal canal and stomach. The female is more gross—often met with in the herring, in large quantities. It is very tenacious of life, for Rudolphi states that he has known it live eight days in a dry place, and even to revive after having been long frozen in masses of ice. It is this species which Zeder and some other naturalists have formed into a *genus*, under the name of *Capsularis.*

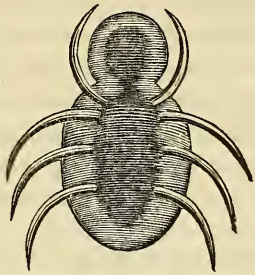
9. *Filaria papillosa.* The *Filaire equi* of Gmelin, and the *Gordius equinus* of other writers. This is the species which inhabits the eye of the horse. It is from one to seven inches in length, and about one-third of a line in diameter. It is usually of a yellowish white or ash color,—sometimes of a brownish hue. Head slightly obtuse; mouth orbicular; neck studded with papillæ; tail slender and curved. It occurs in different parts of the horse, chiefly in the muscles and intestinal canal, though it has been detected in the brain, as well as the aqueous humor of the eye.

M. De Blainville, in the *Dictionnaire des Sciences Naturelles*, describes twelve species of *Filaria*, and mentions thirty-one others, which are doubtful, and whose names are derived from the species of birds, fishes, quadrupeds, insects and reptiles which they inhabit. The points of difference among these do not appear sufficient to constitute them into distinct species, with the exception, perhaps, of the four following, viz. *coronata*, *acuminata*, *plicata* and *alata*, which have been minutely described by Rudolphi and De Blainville. For our knowledge of the others, we are chiefly indebted to Lamarck and Rœssel. The principal animals in which the *Filaria* has been detected are the *vulture*, *eagle*, *falcon*, *owl*, *swan*, *duck*, *stork*, *heron*, *lark*, *starling* and *linnet*, among birds, and the *horse*, *swine*, *ox*, *hare*, *weasel* and *lion*, among quadrupeds; in numerous species of fishes, and coleopterous insects, among the lower orders.

Dr. Nordmann, in his work above referred to, states that he has detected the *Filaria* in the eye of a person affected with cataract, also a hydatid in the eye of a young woman. Ehrenberg agrees with Nordmann in opinion that cataract and some other diseases of the eye, are probably owing to an accumulation of these parasitic animals. This writer has shown very satisfactorily that quadrupeds, birds, reptiles and fishes have each their *eye-worms*, which are, for the most part, peculiar to each species. Several of these are figured in his work; among which, one that infests the eyes of different species of perch, is very conspicuous. In one instance he counted 360 of these in the eye of a single fish affected with cataract. "This little animal," says Kirby in his Bridgewater Treatise, "appears something related to the *Planaria* or *pseudo-leech*, and from Dr. Nordmann's figures seems able, like it, to change its form. Underneath the body, at the anterior extremity, is the mouth, and in the middle are what he denominates two sucking-cups; these are prominent, and viewed laterally form a truncated cone; the anterior one is the smallest and least prominent, and more properly a sucker; the other probably has other functions, since he could never ascertain that it was used for prehension."

It is remarkable that these animals, small as they are, are infested with parasites of their own. These appear like minute brown dots or capsules, attached to the intestinal canal. When extracted and laid upon a smooth surface, these capsules burst, and disclose a great number of living animalcules, of the genus *Monas.*

The accompanying magnified sketch will represent the form of this animal with sufficient exactness.



Achtheres percarum.

Of the worms which Nordmann describes as infesting the eyes of fishes, five out of seven are attached to different species of perch. Kirby conjectures that as these constitute the most numerous body of predaceous fishes in rivers, the object of this singular provision is to impair their organs of vision, so that the roach, dace, carp and tench tribes may not be entirely destroyed.*

Instances of the occurrence of *Filaria* in the human eye, have been recorded by different authors. In a late German medical periodical, (*Zeitschrift fur die gesammte Medicin,* Feb. 1839,) several cases of this kind have been recorded. Blot of Martinique saw two worms in active motion under the conjunctiva, which he removed by incision. One of these, which was sent to M. Blainville, was thread-shaped, thirty-eight millimetres long, with a black protuberance adapted for suction. Bajon, in 1768, observed a Filaria in the eye of a negress, which kept in a continual serpentine motion without producing pain; but it caused a constant epiphora, or watery secretion. When an incision was made the worm went to another part, and was obliged to be secured by a

*It is now a well ascertained fact that animals not only inhabit vegetables, but that vegetable growths are sometimes observed in the bodies of living animals. The most remarkable example of this, perhaps, is that of the "*vegetating wasp*" of our Southern States and the West Indies. The insect, which is a species of *Polystrix,* is infested, while alive, with a parasitic fungus allied to *Sphæria,* which gradually increases so much in size as to destroy the life of the animal, which having deposited its eggs in the plant, perishes; when, in due time, a second generation succeeds, which is cut off in the same manner, and so on. Similar instances have been observed among other insects, in all stages of their development.

small forceps. In a second case the conjunctiva was more inflamed, and the patient refused to submit to an operation. In Blot's case above-mentioned, the worms were between the conjunctiva and the cornea, around and across which they traversed, producing stinging pains and nervous symptoms. The patient, an African negress, was unable to tell where she came from, or whether her fellow-country people were subject to similar affections. The *Cystericus cellulosa* has also often been observed in the human eye, of which there is a case in the *London Medical Gazette* for Aug. 1833, where one was seen in the eye of a little girl six years old, under the *conjunctiva* resting on the *sclerotica,* and perfect in all its parts.

The existence of *Filaria* in the eyes of horses in the East Indies, is of frequent occurrence, as may be seen by consulting an article in the *Edinburgh Medical and Surgical Journal* for Jan. 1826. Bremser states that he saw three worms in the anterior chamber of the eye of a horse at the Veterinary School of Vienna, in 1813. In the *Bulletin des Sciences Medicales* for Feb. 1826, it is stated that Dequilleme saw several of these animals in the eye of a cow, and the case was published by Gohier, a veterinary teacher, in his memoirs. In the report of the proceedings of the Veterinary School at Lyons, in 1822, there is a case in which a *knot* of worms was seen in the eye of a mule. Some of these were extracted; no inflammation followed the operation, but a violent nervous agitation of the head and a turning of it to the left side, took place. In the same journal mention is made of a memoir read before the Medical Society of Calcutta, in which the writer states that the *Strongylus armatus minor* of Rudolphi, and the *Filaria papillosa* are frequently found in the eyes of horses in India, but much more so in the cellular membrane, particularly about the loins. The writer maintains that they make their way into the blood-vessels, and through them into the eye. Treutler says that he has seen the *Strongylus armatus* in aneurisms of the mesenteric artery of the horse, and Dr. Kennedy, in the Edinburgh Phil. Transactions, describes a worm which he calls *Ascaris pellucidus,* but which was doubtless the *Filaria papillosa,* as being common in the eyes of horses in the east. A common effect of these worms in the muscles of the loins is paralysis of the hind legs.* The only case of the kind which has come to my knowledge, as having occurred in our own country, is recorded in the second vol. of the Transactions of the American Philosophical Society. This volume contains two communications on the subject,—one by F. Hopkinson, Esq., entitled "*Account of a worm in a horse's eye;*" the other by John Morgan, M. D., "*Of a living snake in a living horse's eye, and of other unusual productions of animals.*" Mr. Hopkinson reports the case as follows: "A report prevailed last summer that a horse was to be seen which had a living serpent in one of his eyes. At first I disregarded this report, but numbers of my acquaintance who had been to see the horse, confirming the account, I had the curiosity to go myself, taking a friend along with me. The horse was kept in Arch street, and belonged to a free negro. I examined the eye with all the attention in my power, being no ways disposed to credit the common report, but rather expecting to detect a fraud or vulgar prejudice; I was much surprised, however, to see a real living worm within the ball of the horse's eye. This worm was of a clear white color, in size and appearance much like a piece of fine bobbin; it seemed to be from two and a half to three inches in length, which, however, could not be duly ascertained, its whole length never appearing at one time, but only such portion as could be seen through the iris, which was greatly dilated. The creature was in constant lively vermicular motion; somtimes retiring so deep into the eye as to become totally invisible, and at other times approaching so near to the iris as to become plainly and distinctly seen; at least so much of it as was within the field of the iris. I could not distinguish its head, neither end being perfectly exhibited whilst I viewed it, and indeed its motion was so brisk and constant, that so nice a scrutiny was not to be expected. The horse's eye was exceedingly inflamed, swollen and running; I mean the muscles contiguous to the eye-ball, and seemed to give him great pain, so that it was with much difficulty the eye could be kept open for more than a few seconds at a time; and I was obliged to watch favorable moments for a dis-

* A singular case is reported by M. Cloquet, in the *Archives Generales* for Dec. 1827, where a number of small worms were discovered in the eye of a man. On examination, they proved to be the *larvæ* of the common fly, (*Musca carnaria,*) which had been deposited in the form of eggs on the eye while the man was asleep. These afterwards hatched out, and the result was a total loss of vision.

tinct view of his tormentor. I believe the horse was quite blind in that eye, for it appeared as if all the humors were confounded together, and that the worm had the whole orb to range in, which, however, was not of a diameter sufficient for the worm to extend its whole length, as far as I could discover. As this is a very uncommon circumstance, and may affect some philosophical doctrines, it is much to be lamented that the horse had not been purchased, and the eye dissected for better examination. That there was a living, self-moving worm within the ball of the horse's eye, free from all deception or mistake, I am most confident. How this worm got there, or if bred in so remarkable a place, where its parents came from, or how they contrived to deposit their semen or convey their egg into the eye of an horse, I leave for others to determine."

The additional particulars communicated by Dr. Morgan, are that the horse was of a sorrel color, nine years old, and belonged to Dr. Dayton, near Elizabethtown, New Jersey. The first circumstance which attracted the owner's attention was, that from being very mild and gentle, the horse suddenly became vicious and unmanageable, and ran away and dashed the chair to pieces. When seen by Dr. Morgan the worm was about four inches in length, and "as thick as a knitting-needle, or piece of common twine." The aqueous humor was of a white, milky appearance, bordering on the color of a cataract, which was supposed to be owing to a breaking down of the vitreous humor, which had thus discolored the aqueous portion. The iris was thought to be destroyed, but this was doubtless a mistake. At this time the animal passed freely from the anterior to the posterior chamber of the eye, and *vice versa*, which the Dr. supposed could not have happened unless the partition between had been broken down. But it so happens that there is no partition between the two except the thin membrane of the *iris*, through which there is an opening, the *pupil*, of sufficient size to permit a free passage. "It may be presumed," says the writer, "that whatever might be the state of vision, that eye must be now blind. The lids are commonly closed, probably owing to pain excited in the eye by so troublesome a guest; but there is no blood-shot appearance on the cornea, though the surrounding parts, namely, the palpebræ, are a little tumid. To get a view of the eye, the keeper commonly strikes the horse on its back with an open hand, at which, as if frightened, it opens the lid of the left, as well as widens the opening of the right eye, which continues disclosed but a short time; however, this gives an opportunity for inspection for five or six seconds of time together, and the blows must be repeated to keep the eye open when a person wishes to have a longer time for inspection."

The similarity of this case to the one now exhibiting, is too obvious to need remark. In all their essential points there is almost an exact correspondence, viz. the size, color, shape and appearance of the worm; its incessant motion; the cloudiness of the aqueous humor, and the partial blindness of the eye. In the case, however, reported by Mr. Hopkinson, the worm appeared to excite more sensation in the eye, and consequently produced a higher degree of inflammation. This no doubt was occasioned by its passing through the iris, and coming in contact with the expansion of the retina and the delicate *ciliary processes;* whereas in the present case, the animal is confined exclusively to the anterior chamber of the eye, which is comparatively insensible.

Origin.—It is a singular fact that some of the first physiologists and helminthologists of the day, attribute the origin of intestinal and visceral worms to *spontaneous generation.* Such is the opinion of Muller, Bremser, and most of the German physicians. The opinion of Linnæus, that they were terrestrial or aquatic species, taken in with food or drink in the form of ova or germs, is now exploded, for, with the exception perhaps of the *Filaria*, we do not find the same species of worms which infest animal bodies, out of them. Indeed, Cruvelhier lays it down as an axiom, *that worms, like the intestinal and visceral, have never been met with out of the bodies of man and other animals, unless discharged from them;* and the converse of this he holds to be no less true, viz. *that no terrestrial or aquatic worms have ever been met with alive, in the bodies of men and other animals, unless they had been very recently introduced into them.* We might then conclude, with confidence, that worms do not originate from without, but are generated within the body, were it not contended that these animals may have been introduced *ab externo*, but that in consequence of a change of situation and nutriment, their forms and characteristics are altered, as plants and animals are under similar circumstances, and as *neuter bees* are made prolific, on the loss of the queen bee, by feeding in a particular manner. But if such transitions occur in worms, we should sometimes observe them while undergoing the process, for it would be contrary to all analogy to suppose that the change would be sudden. But we see no such transitions; we never find these animals "half way between what they were and what they are." No zoologist, not even Bremser, who devoted twelve years of his life to the study of Entozoa, ever witnessed any such change; indeed, he states expressly, "that after having diligently examined 15,000 specimens of worms in the Cabinet of Vienna, he never was for one moment at a loss to say which were intestinal worms and which were not." If worms then originate within the body, *how* do they originate?—what are the obstacles in the way of our adopting the theory of *spontaneous generation?* In the first place, if they can be formed by the mere combination of inorganic elements, we may well ask, why they should be furnished with reproductive organs? No such creations or combinations have ever been observed, and therefore the fact of their occurrence is a matter of mere supposition. The only argument on which this hypothesis may be said to rest, is our ignorance of the precise mode of their origin, and derives no support from analogy.

If this theory be true, it is difficult to explain why the law should be confined to the lower classes of animals, and not also extend to the higher. By some fortuitous concourse of atoms, we should expect, occasionally, to see a man, a quadruped, or a bird, spring up from some dunghill, or fermenting vat; but this is a phenomenon which even Ovid never dreamed of.

The production of certain species of vegetables was once as difficult to explain, as it now is to account for the origin of intestinal worms; but late investigations have removed these difficulties, and shown that they are propagated in the usual manner by seed or reproductive granules. Thus it is observed that white clover is ready to spring up on soils which have been rendered alkaline by the strewing of wood-ashes, or the burning of weeds; ground newly turned up by the plough is found to produce plants dissimilar to any in their neighborhood; parasitic *fungi* sprout up upon decaying organized substances, and even in the interior of cheese, &c. Dr. Good remarks that he "has seen a hop-ground completely overrun and desolated by the *Aphis humuli*, or hop green-louse, within twelve hours after a honey-dew (which is a peculiar haze or mist, loaded with a poisonous miasm) has slowly swept through the plantation, and stimulated the leaves of the hop to the morbid secretion of a saccharine and viscid juice, which while it injures the young shoots by exhaustion, renders them a favorite resort for this insect, and a cherishing nidus for the myriads of little dots that are its eggs. The latter are hatched within forty eight hours after their deposit, and succeeded by hosts of other eggs of the same kind; or, if the blight take place in an early part of the autumn, by hosts of the young insects produced viviparously, for, in different seasons of the year, the Aphis breeds both ways." The inference which Dr. Good deduces from these phenomena, is, that the atmosphere is freighted with myriads of insect eggs that elude our senses, and that such eggs when they meet with a proper bed are hatched in a few hours into a perfect form. In this manner, damp cellars are covered with *Boletuses*, *Agarics*, and other *fungi*, and walls and rocks with *lichens* and *mosses*. In these cases it is now fully ascertained, that the vegetable is propagated by reproductive granules contained in the *frond* of the *Algæ*, the *spores* of the higher *Cryptogamia*, the *pileus*, or cap of the *Fungi*, and the *pollen* of the *anthers* of the *Phanerogamia*.

If we adopt the theory of spontaneous generation, we not only are obliged to adopt the hypothesis of the *Archeus*, to direct its operations, but we shall be unable to account for the extinction of some races of organic beings; we shall be unable to explain the limitation of the characters of different genera and species, to certain defined limits; and we shall equally be at a loss to account for the non-production of new genera and species. Why is it, on this hypothesis, that each species is produced of nearly a certain uniform size, neither larger or smaller? And why is not the whole mass of matter operated upon by this *spiritus mundi*, changed into organized beings?

Because we cannot, in many cases, actually detect the ova or germs, it by no means follows that they do not exist; and because we find a plant or an animal in some unusual habitat, we are not necessarily obliged to suppose that it could only have been brought into existence by spontaneous generation. It has been well observed, that "there are very few, if any, facts taken in support of the doctrine of equivocal generation, but what may as equally, and perhaps as justly, be used to support the contrary opinion; for it is not the obvious appearance of the organisms, whether vegetable or animal, that is disputed, but the cause of their appearance. A known organism appears in some unusual place from its previously known habitats, or an unknown one is observed in some locality never as yet minutely examined, or at least not made known that it has been examined; the advocates of spontaneous generation immediately say, that our doctrine is the right one is plainly evident, because here an organism has appeared which cannot be accounted for otherwise. Is assertion to take the place of positive facts? and is not this mere assertion? How can we *prove* that there were no germs of that type of organisms in that place where we now observe the organism in question? We find, when we begin to examine it, that it produces germs itself; then by what parity of reasoning can we assert that it has sprung from matter without any previous germ, when we find, in every succeeding instance, a germ is always given for a succeeding organism?" A full consideration of this subject would require an investigation into the nature of the *vital principle* and the *vital powers*, which our limits will not allow; we therefore dismiss the question, with the single remark that it is more in accordance with the dictates of sound philosophy, in all doubtful cases, to acknowledge our ignorance than to attempt to assign a cause to explain such extraordinary phenomena.

Another theory has lately been advanced, which receives the support of some highly respectable names in physiology. It is that worms are produced within the body by some living process or function of the organism, analogous to the secretion of lymph upon a serous surface. An organized portion of matter is thus formed, under the influence of the vital principle of the original animal, which is afterwards thrown off and becomes a separate being, and capable of an independent existence. In answer to this hypothesis it is sufficient to say, that we have no proof whatever of the existence of such formations; that they are contrary to all analogy, and will not explain the identity of characteristics which form the different genera and species. In short, it has no better foundation to rest upon than Bremser's notion that intestinal worms are formed by the presence of semi-assimilated nutritious matter in the digestive tube.

There remains, therefore, but one other theory, and that is the one which attributes the origin of intestinal and visceral worms, in all cases, to ova. Ehrenberg has clearly proved by his careful microscopical observations, that these animals have organs of reproduction clearly developed, and never deficient; indeed, surpassing in development, for the most part, those of other organic systems; thus plainly pointing to a predominant cyclical development, in the same manner as we find in the higher organisms. Ehrenberg has also shown that the fecundity of these animals is most astonishing, each female producing thousands, if not millions of ova at a time. The same diligent and accurate observer states, that if we carefully examine animal bodies, whether of man or other animals, we shall, in nearly all cases, discover worms of some kind, and that we do not meet with more, he thinks is owing to the great difficulties in the way of the development of the ova, among which the resistance of the vital principle is not the least. He therefore believes that the eggs of intestinal worms are taken into the circulation and carried into all parts of the body, but are developed only where the particular conditions requisite for this purpose are favorable. "The smaller diameter of the finest vessels through which they have to pass," he remarks, "does not appear to me to present any important difficulty, because these, as we see in every inflammation, become easily and quickly expanded as soon as they are irritated; and these eggs may, as excretive bodies, like every body which is foreign to our organism, act in an irritative manner, and may be taken up by the embouchures of the absorbents and be propelled along with increased activity through them; that this is the case with mercury, pus and other matters, has been already received as an observed fact. It is even probable that the eggs of the *Entozoa* and their propulsion through the vascular system may be an important morbid matter hitherto overlooked, and which causes a part of the phenomena comprehended under the name scrofula. In bodies which are particularly favorable to the development of worms, there must necessarily be an innumerable quantity of secreted eggs of these parasites, which, if they are not expelled by the intestinal canal or by the *primæ viæ*, must, as foreign bodies, produce disorders. If the absorption takes place entirely or for the most part in the lymphatics, it would occasion their general or sole influence upon that system. Obstructions in the lymphatics, but especially in their reticular tissue, the glands, which lead to local congestions of lymph, inflammations, and morbid appearances of various kinds, become in this manner very easy of comprehension; and these assuredly deserve the attention of medical science, not as speculations, but as realities. Thousands of eggs of intestinal worms, whose existence in many bodies can not be denied, must perish, as they are rarely developed in such great quantities from the difficulty of their attaining the place and conditions favorable for their development; while only some, very often none, ever actually attain those conditions. This relative proportion of the number of intestinal worms and of their eggs to the organs of the larger animals, is also found to exist. There are very often observed in animal dissections a small number of full-grown worms, filled with an innumerable quantity of eggs, without any young in their proximity; and I was often astonished to find in the considerable number of my dissections of animal bodies, (I have brought from Africa alone intestinal worms of 196 species of animals, all of which I have myself dissected, and of some from 40 to 50 individuals,) only a few alive, although these were completely filled with eggs. Thus from laborious observations this opinion has become more and more firmly fixed in my mind, that it is much more astonishing how the great fecundity of the Entozoa should be so limited by the living organs, than that it should be possible that living worms should inhabit them, and, considering their diffusion, escape observations which are generally superficial."

Such are the views of this very able naturalist on this difficult subject, and I believe they are those which eventually will be generally adopted. In this manner can we only satisfactorily account for the existence of worms in the fœtus of man and other animals, and in the intestines of chickens and the young of other birds, which have just broken the shell; numerous instances of which have been recorded by Rudolphi, Blumenbach and others. I see no great difficulty in the supposition that these ova are absorbed by the lacteals and lymphatics, and carried into the circulation, as they are known to be smaller than the particles of quicksilver, and the coloring matter of madder, &c., which it is well known are constantly taken up and deposited in the bones and other tissues of the body. We believe then that it is in the highest degree probable, if not actually proved, that the minute ova are thus introduced into the blood, carried to every part, and *there* only hatched, where they meet with a suitable *nidus* or *pabulum*, and other circumstances are favorable to their development.* Thus are they transmitted from parent to offspring, and thus do we account for the fact that each species of animal has its own parasites. In this manner the ovum of the *Filaria* was deposited in the eye of the horse now exhibiting in this city, there hatched into existence, and where it may now be seen, reveling in an element which appears, so far as we can judge, to be highly congenial to its nature and habits.

New York, June 24, 1840.

Postscript. July 22, 1840.—Since writing the above I have seen numerous Filaria in *eels* and *black-fish*, chiefly on each side of the spine; and the fishmen inform me that they have seen them in the eyes of fishes. Mr. A. Halsey also stated at the meeting of the Lyceum, after the above paper was read, that he had often seen Filaria in coleopterous and other insects. I have ascertained that they are extremely tenacious of life, and will not only bear *freezing*, but a temperature little inferior to that of boiling water, without depriving them of life. Professor Owen of London, the celebrated comparative anatomist, estimates the number of ova in one *Ascaris lumbricoides* which he examined, at 64,000,000. (*Lancet*, June.) The fecundity of the Filaria is probably not inferior.

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* "A very curious disease of the eye has in a few instances been observed. The common symptoms of ophthalmia appear, as injection of the conjunctiva, dimness of the cornea, weeping and swelling of the cornea. These are properly attended to, but the inflammation increases; and on very close examination, a *small white worm*, about the size of a hair and an inch in length, is found swimming in the aqueous humor, or that fluid which is immediately behind the cornea. Now it is at once evident that the only way to get rid of or to destroy this worm, is to puncture the cornea and let it out; and this method has been resorted to. In some cases, however, not many days pass before another worm makes its appearance, and the operation is to be performed a second time, and the horse eventually loses that eye. A veterinary surgeon, M. Chaigrand, who seems to have had most experience about this, says that three or four days before the appearance of the worms, *one or two minute bodies, of a reddish white color, are seen at the bottom of the anterior chamber of the eye.* He also says, that the disease appears about June, and is not seen after December. There is no difficulty about these animalcules getting into the eye, for there are undisputed instances of their passing through the smallest capillaries, and being found in almost every tissue."—*Youatt on Cattle, p.* 293.

Art. VI.—*An Attempt to determine by Experimental Research the true Theory of the Pneumatic Paradox;* by Jos. Hale Abbot, of Boston, Mass.

In the year 1828, the following experiment, sometimes denominated the Pneumatic Paradox, was published in various journals in this country. "Cut a couple of cards each into a circle of about two inches in diameter; perforate one of these in the centre, and fix it on the top of a tube, say a common quill; make the other ever so little concave, and place it over the first, the orifice of the tube being thus under and almost in contact with the upper card. Try to blow off the upper card—you will find it impossible."* To it was appended a statement, presumed to be apochryphal, that the Royal Society of London had offered a reward of one hundred guineas for a satisfactory explanation of it. Several have been published, both in this country and in England, but none that I have seen seem to me admissible, either because the experiment may be so modified as wholly to set them aside, or because the principle on which they are founded may be demonstrated to be false.

One explanation attributes the adhesion of the disks to the rarefaction of the air, as it issues from the mouth, on account of its

* It is not material that the movable disk should be concave. The whole of the apparatus may be made of sheet brass or tinned sheet iron, which has the advantage of admitting a short pin to be soldered to the centre of the movable disk, to prevent it from sliding out of place. In this case, the disk may be perfectly plane. The diameter of the movable disk need not exceed that of the tube more than three or four times, and either disk may be placed uppermost. The phenomenon was observed almost simultaneously in the latter part of the year 1826, by several individuals in France, and by Mr. Roberts, of Manchester, in England. I extract the following interesting account of the circumstances which led the latter gentleman to make the discovery, from a late number of the London Mechanics' Magazine. "Several years ago, Mr. Roberts had constructed an apparatus for ventilating his manufactory. A pipe conveying a blast of air terminated close to the wall of the principal apartment; and with a view to regulate the quantity of air to be introduced, he placed a valve over the terminus of the blast pipe, but found to his surprise that the most powerful blast of air would not lift the valve, (which was merely a piece of flat board,) but that it even held the valve firmly down over the mouth of the pipe, so that the strength of one man was insufficient to withdraw it. This experiment has often been shown to visitors as one of the curiosities of Manchester."

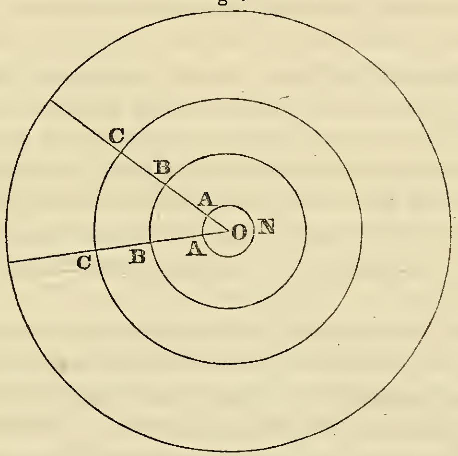
being of a higher temperature than the surrounding air. This explanation is set aside by the fact, that if a pair of bellows be used instead of the lungs, the experiment succeeds equally well.

Another explanation published in his youth by Charles G. Page, M. D., a gentleman well known to scientific readers, both in this country and in Europe, for his inventions and discoveries in electro-magnetism and magneto-electricity, originally communicated to this Journal, ascribes the phenomenon to currents of air which strike against the movable disk nearly at right angles to its plane, and which give it a tendency to adhere to the fixed disk. He demonstrated the existence of these currents, by admitting into a darkened room through a hole in the shutter, a beam of light, and scattering a little dust in the beam, so that the direction of any currents of air might be indicated by the motions of the particles of dust. These currents are caused by the air which issues from between the disks, carrying with it some of the contiguous air, into the place of which they rush nearly at right angles with the disk. They are evidently inadequate to cause the adhesion of the disks, since they cannot have a momentum greater than that of the aforesaid contiguous air, which is much inferior to that of the original blast. That they are not essential to the adhesion of the disks, may be demonstrated by the following experiment. Make of thin letter paper a hollow cylinder, of the same diameter as the disks, eight or ten inches long, and tight at both ends. Upon the mouth of a jar place a cover having a circular hole large enough to admit the cylinder without friction, and through this hole sink the cylinder till it projects but little above the cover. On applying the fixed disk to the superior base of the cylinder, and blowing with a strong and long continued blast through the tube, the cylinder may, against its own gravity, be raised from the bottom of the jar, and even be lifted entirely out of it. In this case it is obvious that the cylinder cannot be sustained by currents underneath, and, of course, that such currents cannot be essential to the adhesion of the disks. The same thing may be likewise shown in the following manner. Let a newspaper be pasted to a table by the edges in such a manner as to occasion no tension, and, on applying the fixed disk to the middle of it, and blowing strongly through the tube, that part of the newspaper may be sensibly raised from the table. In this and in the preceding experiment, the tube should be at least a quarter of an inch in diameter.

The most recent explanation of the pneumatic paradox that has come to my knowledge, is extracted in the number of the Annals of Electricity, &c., for August, 1838, from a work on "The Causes of Planetary Motions," by Jabez Allies, Esq., who infers from the adhesion of the disks, the general principle, that "air in a state of agitation, or currents, whether it be cold, as from bellows, or warm, as from the mouth, is in a more rarefied state than the surrounding atmosphere." This is certainly a very summary method of solving the difficulty. So far is this principle from being true, that it may, I think, be satisfactorily shown, that when air is expelled from the lungs or from a pair of bellows, it is in a denser state than the surrounding atmosphere. The reason is obvious; the air, both in the bellows and in the mouth, is condensed at the moment of its expulsion by mechanical pressure, and, as it issues into the open air, it meets with resistance to its expansion; so that not only the current itself must be in a denser state than the surrounding atmosphere, but it must condense in a greater or less degree the air against which it is impelled. These reasonings are verified by the following experiment. Make upon a small, square rod, a tube of tissue paper, which, when the rod is withdrawn, will retain its form. Fasten this to a tube of metal, or other hard substance, of at least *equal bore*, and blow strongly through it, either with the bellows or the lungs. The sides of the paper tube will become convex, and, of course, the tube itself nearly cylindrical. This proves conclusively, that the current of air in the tube is more dense than the exterior air, since the tube, instead of being compressed, as would be the case, if the contained air were in a rarefied state, gains, according to the doctrines of isoperimetrical geometry, an actual increase of capacity by its change of form. Instead of a square tube, a cylindrical one may be used. In this case, any rarefaction of the contained air, would be indicated by a greater or less degree of compression of the tube, which does not take place. The idea most naturally suggested on observing the adhesion of the disks, and the correct one, is, that it must be caused by the rarefaction of the interposed air; but the difficulty of assigning any satisfactory reason for the rarefaction, seems to have driven all who have attempted to explain the phenomenon, with the exception of Mr. Allies, to seek some other cause of it. This gentleman, unwilling to relinquish the idea of rarefaction, regards the adhesion of the disks as a particular case of a general principle which he deduces from it, but which, as has been shown, may be demonstrated to be false. There still remains, therefore, the principal difficulty, of which I now proceed to offer a solution.

For the leading ideas contained in it, I am indebted to the late Samuel Abbot, Esq., of Wilton, N. H. The experiment was described to him in June, 1828, by O. W. B. Peabody, Esq., now of this city, during the session of the Legislature of the State of New Hampshire, of which they were then both members. After a little reflection, he suggested to Mr. Peabody, and subsequently to me, substantially the following explanation.

Fig. 1.



Let the accompanying figure represent the space between the two disks, O its centre, AAN the circumference of a circle of the same diameter as the tube to which the fixed disk is adapted, and corresponding to the tube when the two disks are applied to each other. Let the distance of the two circles AA, BB from each other, be equal to that of the two, BB, CC. On blowing through the tube, the air radiates in all directions from the circle AAN. As any portion of air recedes from the centre, that, for instance, which at one moment occupies the space AA, BB, it continually expands, so that with the same velocity, it would the next moment fill a much larger space, BB, CC. The same effect takes place with respect to every other portion of air, as it recedes from the centre. The interposed air becoming thus rarefied, does not possess sufficient elasticity to counteract the exterior atmospheric pressure, and the two disks consequently adhere. The rarefaction is maintained during the continuance of the air-blast, by the impulse of the outward currents against the surrounding atmospheric air, which prevents it from rushing into the space between the disks to restore the equilibrium.*

It is to be further observed, that the reaction of the radiating currents against the air in the circle AAN, together with the collision of the air-blast, must cause a certain quantity of air to remain stationary at the centre of the disk, and assume a somewhat conical form.† The air-blast strikes obliquely against this conical mass of air, and consequently acts with only a part of its force to separate the disks.

The experiment explained above, suggests a very important caution in regard to the form of safety valves to steam boilers. If they are so constructed, that the steam, when it escapes, must radiate from the centre of and between two parallel surfaces, they will adhere with such force, that instead of being efficient safeguards against explosions, they will serve merely to delude into a false security, not to avert the danger of those dreadful catastrophes.

Addition.—The preceding part of this article was written several months since, and I was not then aware that any other explanation of the pneumatic paradox, than those of which I have endeavored to expose the fallacy, had been published. I was subsequently informed by a friend, that one appeared several years ago in the Journal of the Franklin Institute. On consulting that work, I found, in the number for July, 1828, three explanations, one by the distinguished philosopher Prof. Robert Hare, of Philadelphia, one by Prof. James P. Espy, since extensively known

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* For an account of a secondary rarefaction additional to that described in the text, see the latter part of the article.

† An analogous fact respecting jets of fluids striking against an obstacle of equal diameter, is stated by Dr. Young in his Lectures on Natural Philosophy, Vol. I, p. 302, and represented by figure 273.

as the author of a new theory of storms, and one by Mr. Asa Spencer. Another explanation, different in some respects from either of the preceding, is contained in the number of the London Mechanics' Magazine for June, 1839.

Professor Espy's solution of the phenomenon, is in some respects similar to Mr. Abbot's, though, we if may judge from the date of its publication, posterior in point of time. Being supported, however, exclusively by theoretical reasonings, it has left the question still open to dispute, and the contradictory opinions, which from time to time have since been advanced on the subject, would seem to show, that an attempt to detect their errors, and to establish the true theory, on the basis of direct, unequivocal experiment, would not be a work of supererogation.

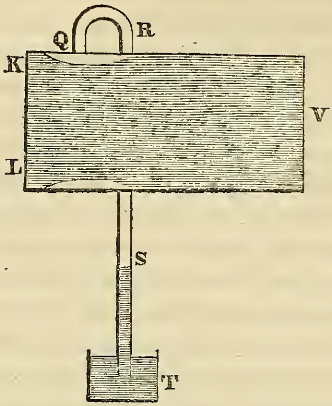
Prof. Hare, whose explanation is similar, as it respects its leading principle, to that of Dr. Page, attributes the phenomenon to the afflux of air against the disks, occasioned by the radiating currents carrying with them, as they issue from between the disks, some of the contiguous air. He demonstrates by a very ingenious process of reasoning, that the velocity with which the two disks tend, from the force of the blast, to move asunder, is as many times less than the velocity of the blast, as the area of the movable disk is greater than the area of the orifice of the tube. Thus if the diameter of the disk and that of the orifice be as eight to one, the area of the former must be sixty four times greater than that of the latter, and consequently, in this case, the disks have no tendency to move asunder with a velocity greater than one sixty fourth of that of the blast. Hence he infers, that the blast tends to communicate only a very small velocity, and inclines with a very small force to separate the disks. It has been shown that the afflux of air against the movable disk, though as the experiment is usually performed auxiliary, is not essential to the adhesion of the disks. It is however adequate to sustain the mere weight of a second disk of letter paper, and of the same size of the first, as may be thus shown. Through the centre of the movable disk, to prevent it from sliding out of place, let a small needle pass and project on each side. Having made a small hole through the disk of letter paper, so that it move freely on the needle, place it underneath the movable disk, and both underneath the fixed one. On blowing through the tube, the disk of letter paper, being protected from the impulse of the blast, will be sustained against its gravity by the afflux of air against its under side.

Mr. Spencer's very ingenious explanation is founded on the principle, to use his own words, "that currents of fluid, whether elastic or non-elastic, exert no force but in the direction in which they move; the latter is fully proved by forcing air or water through a cylindrical tube; if holes be made through the sides of the tube, none of the fluid will escape." A late writer, in a London scientific journal, expresses the same principle thus: "It is a well known property of fluids that they transmit their pressure equally in all directions; but this law applies only to fluids in a state of rest. When they are in motion, they are subject to the laws which regulate the motions of solids, and do not transmit any lateral pressure, except where they meet obstacles to their onward motion." Hence it is inferred, that the currents which radiate from the centre of the disks, exert no pressure against their internal surfaces, and that, as the impact of the blast is not sufficient to overcome the exterior atmospheric pressure, the movable disk consequently adheres.

This inference seems necessarily to follow, if we admit the correctness of the alledged principle of hydraulics from which it is deduced. The only proofs of the principle, as applied to liquids, I have seen cited—not by Mr. Spencer, who cites none—but by others, are the experiments of Bossut and Venturi, both philosophers preeminently distinguished for their experimental researches and discoveries in hydrodynamics. It may however be asserted without fear of contradiction, that whoever carefully reads Venturi's original work "on the Lateral Communication of Motion in Fluids," cannot fail to perceive not only that he nowhere advances such a general proposition, but that it is irreconcilable with his reasonings in several parts of the work. He describes but two or three experiments with cylindrical tubes that lend any semblance of support to it, and it is hardly necessary to say, that the very novel and interesting results he obtained with tubes of a different form, or with long, descending, cylindrical tubes, are so inseparably connected with the peculiar form, or the position of the tubes employed, as to furnish no evidence of the general principle alledged by Mr. Spencer.

The following is the experiment of Venturi, cited in proof of it.

Fig. 2.

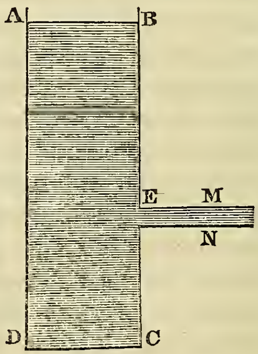


To an orifice near the bottom of a reservoir, in which water was maintained at the constant height of 31.5 inches above the centre of the orifice, he adapted the tube KLV, one inch and a half in diameter, and four inches and three quarters in length. Into the tube KLV was inserted the glass tube QRS, at the distance of two thirds of an inch from the orifice KL. The lower end was plunged in colored water, contained in the vessel T. The efflux of water through the tube being permitted to take place, four cubic feet flowed out in thirty one seconds, and the colored water in T rose in the tube to S, twenty four inches above the surface of the water in T. The branch RT was shortened so that RT was only six inches longer than RQ, and the colored liquid in T rose through RS, and mixed with the water that flowed from the reservoir through the tube KLV, and in a short time the water in the vessel T was emptied. The same effect takes place when the tube KLV is directed upwards or downwards.

The true explanation of these and kindred experiments of Venturi, is found in a fact, apparently overlooked by those who have adduced them as proofs of the general principle, that liquids flowing through a horizontal cylindrical tube, exert no pressure against its interior surface. When water flows through a circular orifice in a thin plate, the jet, in consequence of "the interference of the particles of the fluid coming from the parts on each side of the orifice with those which are moving towards it," becomes contracted, and then again enlarged; so that at the distance from the orifice equal to its semidiameter, where the greatest contraction takes place, the diameter of the stream is about eight tenths, and of course its area about two thirds of that of the orifice. Sir Isaac Newton gave the contracted part of the jet the name of *vena contracta*. The same phenomenon occurs when a cylindrical tube is adapted to the orifice. It will be perceived, therefore, that in the experiments of Venturi just described, the water did not entirely fill the tube at the part where the glass tube was inserted. Now flowing liquids in contact with air in a state of rest, carry along with them a portion of the contiguous air, and this effect taking place within the tube at the place of the vena contracta, the air in the glass tube becomes rarefied, and its elasticity being thereby diminished, is no longer sufficient to resist the atmospheric pressure upon the colored water in the vessel T, which consequently rises. Venturi, well aware, without doubt, though I do not recollect that he states the fact, that the ascent of the colored water was dependent upon the vena contracta, describes no attempt to obtain a similar result by inserting the glass tube at any other part of the tube KLV, and he was far from applying to the whole tube, like some recent writers, a conclusion true of only a small portion of it.

The only direct evidence, as it respects liquids, of the proposition of Mr. Spencer, that has come to my knowledge, is a single experiment of Bossut, described in his work entitled "Traité Théorique et Expérimental d' Hydrodynamique," the first edition of which was published in the year 1771. The following translation from the edition of 1796, comprises Bossut's description of the experiment, and his remarks thereupon. Let the cylindrical horizontal tube EN be adapted to the reservoir ABCD; and let us suppose this reservoir to be kept constantly full to the height AB, and the water to flow freely in the tube without meeting with any resistance. It is certain that, if we except the pressure which results from the weight of the column of water EN, the tube expe-

Fig. 3.



rie^ces no effort; for the velocity of the water having a free and horizontal direction, there can result from it no force which will exert itself against the interior surface of the tube. If proof of this is desired, it is furnished by the following experiment.

To a large reservoir I adapted a horizontal tube three feet long and nine or ten lines in diameter. Near the middle of it a small lateral hole was made, destined to form a jet which could be directed upwards or downwards, or inclined at pleasure, by turning the tube on its axis. The water was kept in the reservoir at the height of about four feet above the tube. When the end N was stopped, the jet had the height such as has been already determined; but when the end N was unstopped, the jet ceased almost entirely in all directions. Only when the hole M was directed downwards, the water dropped a little by its edge. It is evident that the cessation of the jet demonstrates the cessation of pressure against the interior surface of the tube.

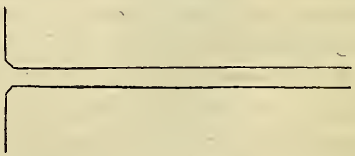
The result thus obtained by Bossut appeared to me so much at variance with what we should expect *a priori*, when we compare the rapid propagation of pressure in liquids with the very moderate velocity of water issuing from an orifice with a head of only four feet, that I was induced to repeat, with various modifications, the foregoing experiment. Having in all of them arrived at similar results, I think I may, without fear of mistake, venture to ascribe that of Bossut to some inaccuracy in his mode of performing the experiment. The grounds of this inference are immediately subjoined.

Experiment I. To the stop-cock of a copper condensing chamber having a bore of one eighth of an inch in diameter, was adapted a common brass tube of the same diameter, and about eight inches long, which had three lateral holes at intervals of an inch or two from each other, varying in diameter from an eighth to a twentieth of an inch. Great care was used in making these holes not to leave the slightest protrusion on the inside of the tube, and in no respect to change its form. The condensing chamber having been partly filled with water, and a quantity of air condensed into it above the water, the stop-cock was opened, and the water being forced through it by the elasticity of the condensed air, in any position of the tube strong jets of water issued from the lateral holes, reaching, when the tube was in a horizontal position and the holes were directed upwards, the height of several feet.

Experiment II. A reservoir was made five feet high and eight inches square, and into one of its vertical sides, six or eight inches from the bottom, was set, like a pane of glass in a window, a square piece of tinned sheet iron, to the middle of which had been soldered, so as to have one end exactly even with its inner surface, an English smooth-drawn or triblet tube, twelve inches and a half long, and three eighths of an inch in diameter. This kind of tube was selected on account of its being, from the manner in which it is made, perfectly cylindrical. The one used in this experiment, which was the longest in proportion to its diameter I could obtain in this city, had a very highly polished interior surface, and was in every respect suited to afford exact results. A lateral hole, one line in diameter, which was now directed upwards, had been previously made in the middle of it, with great care to have no protrusion on the inside, and not to impair in the slightest degree its cylindrical shape. The outer end of the tube being stopped with a cork, and a strip of oiled silk tied over the hole, the reservoir was filled with water. On removing the oiled silk, a vertical jet rose to the height of forty seven inches. The reservoir being kept full, and the cork withdrawn, the water flowed through the tube, and the jet, not ceasing as in the experiment of Bossut, assumed an oblique direction, making an angle with the horizon of forty or forty five degrees. The greatest height it attained above the level of the tube, which had been previously adjusted in a horizontal position by means of a spirit-level, was twelve and a half inches, and the distance to which it was projected before descending to the same level, was twenty four inches.

Experiment III. To one end of a tube, similar in every respect to the one used in the preceding experiment, was soldered, in order that water flowing through might entirely fill it throughout its whole extent, an ajutage nearly of the form of the vena contracta. The accompanying figure represents, though imperfectly, the tube with the ajutage soldered to a piece of tinned sheet iron, which was set in the side of a reservoir, and every thing arranged as in the preceding experiment. The end of the tube being stopped, and the water allowed to issue through the

Fig. 4.



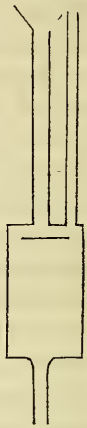
lateral hole, the jet rose vertically, as in the preceding case, to the height of forty seven inches. The end of the tube was then unstopped, and the jet becoming inclined at an angle of forty or forty five degrees with the horizon, attained the height of sixteen or seventeen inches above the level of the tube, and the distance of thirty inches before descending to the same level. The force of the jet was not apparently diminished by inclining the reservoir, so as to give the tube an ascending or descending direction. By diminishing the head of water, a corresponding diminution was produced in the height of the jet.

Experiments similar to the two last described, with the exception of the substitution of drawn leaden tubes, both with and without an ajutage, and of the same dimensions with those employed by Bossut, gave results not materially different from the preceding. The tubes were one eighth of an inch in thickness, which interfered with the natural direction of the jet, and somewhat diminished its height, and it was almost impossible to pare away the lead about the holes sufficiently to obviate this obstruction, without impairing the cylindrical shape of the tubes. On this account, therefore, and because of the imperfection of their interior surface, experiments made with them are less to be relied on than those which I have already described. They were sufficient to show that mere difference of size produces no material discrepancy of results.

The foregoing experiments demonstrate a pressure against the inner surface of horizontal and inclined tubes, independent of that which arises from the column of water contained in them. Of this pressure the lateral jet, though it proves its existence, cannot be regarded as a measure. Its oblique direction, and the consequent obstruction presented by the thickness of the tube, together with the diminution of pressure arising from the expenditure of the jet itself, prevent it from reaching the height due to the actual lateral pressure exerted by the flowing water, when the hole is closed.

Experiment IV. In order to determine whether lateral pressure takes place in vertical descending tubes also, I procured a cylindrical vessel of tinned sheet iron, thirteen inches in height and nine inches in diameter; to the centre of the bottom, where a perforation had been made, was soldered the triblet tube, furnished with an ajutage, used in Experiment III, having two lateral holes, each one line in diameter, and situated two and six inches respectively below the ajutage. To the top were soldered two leaden tubes, the larger six feet high and three quarters of an inch in diameter, and surmounted by a funnel; and the smaller somewhat shorter, and terminating above in a glass tube. A shelf of tinned sheet iron five or six inches wide, was soldered to the opposite sides of the vessel, so as to cross it two inches from the top, under the end of the larger tube. The accompanying figure exhibits the form, though not the relative proportions, of the several parts of the apparatus. The whole was supported by frame-work, not seen in the figure. The end of the descending tube, and also the lateral holes, being stopped, and the vessel and tubes being kept full of water to the brim of the funnel, which was somewhat more than seven feet above the bottom of the vessel, on removing the oiled silk from either lateral hole, a horizontal jet issued, which reached the distance of seven and a half feet before falling to the brick pavement, situated two and a half feet below the bottom of the vessel. On unstopping the lower end of the triblet tube, the water immediately sunk nine inches in the small glass tube below its level in the large tube, showing a diminution of the effective head to that amount. Meanwhile the jet continued to issue from the lateral holes, but it assumed, owing to the joint action of onward and lateral forces, instead of a horizontal direction as before, an oblique downward one, which would of course prevent its attaining the random due to the actual pressure against the surface of the tube, and it reached the pavement at the horizontal distance of a little more than three feet. The distance became less by diminishing the head of water. Jets of nearly equal force issued from the lateral holes when a similar descending tube without an ajutage was used.

Fig. 5.



This result completes the proof of the proposition I have been endeavoring to establish, that water, flowing through a cylindrical tube, whether in a horizontal, inclined, or—if short—in a vertical position, exerts, contrary to the principle laid down by Bossut and others, a lateral pressure, varying with its incumbent head and independent of its weight, against the interior surface of the tube. This proposition is subject to one or two limitations. When, in Experiments III and IV, the water in the reservoir was allowed to discharge itself to the level of the tube, it ceased to escape in the form of a jet, though not to drop from the lateral holes, after its head was reduced to a few inches, and in the case of tubes not having an ajutage, after it was reduced to a little more than a foot. Also, if descending tubes of considerable length be employed, there will be no lateral jet beyond a certain depth, since in obedience to the laws of falling bodies, the descent of the water will be constantly accelerated by gravity; and this effect will finally become such as to overcome the mutual adhesion of the particles, and the lower portions becoming detached from those above, will leave void spaces, into which, if lateral holes be made, the surrounding air will rush, and be carried down with the stream.

I have described the foregoing experiments with considerable minuteness, on account of the importance they possess, independently of their connexion with the main object of the present article, as proofs of a controverted if not new principle of hydraulics. They do not prove that the lateral pressure of water flowing through cylindrical tubes is *equal* to that of water in a state of rest under the same head. It is undoubtedly less, but to determine in what precise degree it is less, would be an exceedingly difficult problem, the solution of which is not necessary to my present purpose.

It remains to be shown that Mr. Spencer's proposition is false, as it respects aeriform fluids as well as liquids. The experiments with the tubes of tissue paper, described in the first part of this article, prove not only that air in a state of motion is not, as a necessary consequence, in a rarer state than the surrounding atmosphere, but that, when it is blown through tubes of a uniform bore, and having orifices equal to that bore, it exerts a lateral pressure. The following additional experiments corroborate the same conclusion.

Exp. I. Make with care several holes of various sizes, from a twentieth to an eighth of an inch in diameter, and at intervals of an inch or two, in a brass tube one eighth of an inch in diameter; on blowing strongly through it, the air will issue in an oblique direction from either hole, when the others are stopped, with such force as to extinguish a common lamp. Likewise, if a narrow strip of tissue paper two inches long be held in the hand by one end, so that the other may rest against the hole, it will be blown away from it. To obtain more exact results, I used a brass triblet tube similar to those already described, twelve and a half inches long, and three eighths of an inch in diameter, and having a lateral hole in the middle one line in diameter. The sectional area of the tube, therefore, was twenty and a quarter times greater than the area of the hole; consequently, the latter would not, even on the supposition that the lateral and outward forces are equal, permit the issue of so much as one twentieth of the air expelled from the mouth; notwithstanding which, the lamp was readily extinguished, and the strips of tissue paper repelled by the lateral jet of air.

These results prove beyond the possibility of doubt, the fact of the lateral pressure of air forced through cylindrical tubes. It is not important to determine the comparative intensity of the onward and the lateral force; the latter must be greater than the exterior atmospheric pressure, since the lateral jet could not otherwise take place. This fact being incompatible with the fundamental principle by which Mr. Spencer explains the adhesion of the disks, his hypothesis necessarily falls to the ground.

A writer in a late number of the London Mechanics' Magazine, maintains, on the authority of an experiment of Mr. Tomlinson, that the movable disk is not retained in its place during the continuance of the air-blast by exterior atmospheric pressure. Assuming also the principle which has just been disproved, that currents of air flowing through tubes exert no lateral pressure, and applying it to the currents that radiate from the common centre of the tube and disks, he asserts that "the disk is not removed because there is in fact no force to effect its removal." He overlooks the tendency of the impulse of the blast to separate the disks, and leaves the adhesion of the movable disk *against its own gravity*, when it is placed underneath, unaccounted for, unless he means to be understood to refer it to what he calls "the attractive force of the air-blast," when it is "spread out in a thin film" between the disks. The necessity of having recourse to so novel a supposition, will be obviated by the results I obtained in repeating the following experiment of Mr. Tomlinson.

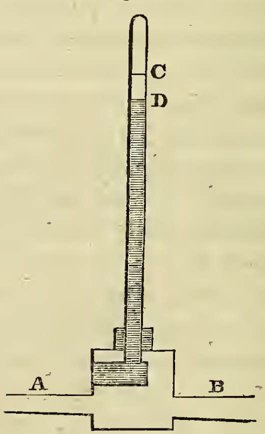
"Let a brass tube, open at both ends, and terminated at the end by a perforated screw, be fixed to the table of an air-pump.

A disk of card two inches in diameter, is placed horizontally at the upper end of the tube. Another card of the same size made slightly concave, is placed over the first. Let the whole be covered with a glass receiver; then let the air be removed, which of course can only quit the receiver by passing out through the brass tube; when the exhaustion is carried to the utmost limit, let the air be readmitted in a full gush through the brass tube, and the upper card will not be blown off. This experiment has been tried many times with various states of exhaustion, from a quarter of an inch of mercury to twenty inches, but in no case was the card blown off, or even agitated in the slightest degree; therefore the upper card is not retained in its position by the pressure of the atmosphere."

Mr. Tomlinson's failure to blow off the disk may have arisen from the concavity of the upper card, from not carrying the exhaustion far enough in proportion to the size of the movable disk, or from the warping of the cards, which, owing to the evaporation of moisture usually contained in their substance even when apparently quite dry, is very apt to take place as the exhaustion proceeds. To obviate this difficulty, the fixed disk may be made of tinned sheet iron or brass, and the movable one of the same material, very thin and light, or of card recently dried by exposure to heat, and pressed, in order that both disks may be perfectly plane and in contact throughout their whole extent, when applied to each other. For the convenience of suspending, during the process of exhaustion, the movable disk from the top of the receiver, by means of a rod sliding through a collar of leathers, and also to prevent it from moving laterally out of place, a cambric needle may be passed through its centre, projecting, when the two disks are applied to each other, about an eighth of an inch into the tube. I repeated Mr. Tomlinson's experiment with a very powerful air-pump, recently made for the University of Cambridge by N. B. Chamberlain of this city. The passage by which air is admitted into the receiver is one eighth of an inch in diameter. Every thing having been adjusted as above described, the air was exhausted to such a degree as to reduce the mercury in a very accurate syphon gauge to within one tenth of an inch of a level in the two branches, indicating a residue in the receiver of only one three hundredth of the air naturally contained in it. By means of two stop-cocks the air was first admitted into the air passage and barrel, and then in a full gush into the receiver through the tube, when a disk of card three inches in diameter was immediately blown off. I repeated the experiment with a very excellent air-pump, made by Mr. Joseph Wightman of this city, capable of producing the degree of exhaustion just described, and having a passage for admitting air into the receiver one fifth of an inch in diameter. The tube to which the perforated disk was adapted being of the same diameter with the air passage, and the latter being closed with the thumb, and the air exhausted to the one two hundred and fortieth part, on suddenly removing the thumb a circular card three inches in diameter, and on another trial, a disk of tinned sheet iron two inches in diameter and weighing forty nine and a quarter grains, were blown nearly to the top of the receiver. By reducing the size of the disk, a less degree of exhaustion becomes necessary in order to blow it off. If it does not exceed one inch in diameter, it is not necessary to exhaust the air to more than a sixtieth part, though I have found it impossible, when the apparatus is adapted to the stop-cock of a condensing chamber, the tube being one eighth of an inch in diameter, to blow off a movable disk one inch in diameter by means of a very powerful current of highly condensed air.

Having completed the ungrateful labor of pointing out the errors of the various theories that have been proposed to explain the pneumatic paradox—which seemed however a prerequisite to the undisputed admission of the correct one—I now proceed to adduce the proofs of the theory contained in the first part of this article.

Fig. 6.



Experiment I. In order to show that rarefaction may be produced in a space having a free communication with the external air, I cite the following experiment of Hauksbee.

In two opposite sides of a small box holes were made, one somewhat larger than the other, and to these holes were adapted the short tubes A and B, seen in the accompanying figure. Through the top passed in an air-tight manner a barometer tube, the lower end being immersed in mercury contained in a basin supported in the upper part of the box. Having forced into a condensing chamber, by means of a syringe, three or four times as much air as it naturally contained, he directed a very rapid current through the tubes A and B, and the mercury was depressed from C to D, more than two inches, in consequence of the rarefaction which the current produced in the air of the box.

Experiment II. In order to determine to what degree air can be condensed by means of the mouth and lungs, I poured a quantity of mercury into a glass tube, bent into the form of the letter U, and furnished at one end with a brass cap, stop-cock, and mouth-piece. The greatest difference that could be produced in the height of the mercury in the two branches of the tube by blowing through the stop-cock, was found, in a series of trials made by half a dozen able-bodied men, to vary from two and a half to nearly four inches. This result shows, that the degree of condensation producible by this means, ranges from a twelfth to less than a seventh of an additional atmosphere. The condensation producible by blowing through a tube presenting no obstruction to the escape of air, is obviously much less. One of the individuals mentioned above was able to exhaust fourteen fifteenths of the air from a tube having the lower end immersed in mercury, and the other furnished with a stop-cock, as was shown by the rise of the mercury in it to the height of twenty eight inches.

Experiment III. Make a cylindrical tube of tissue paper, about three fourths of an inch in diameter and five or six inches long, and fit into one end of it a circular piece of wood, having a hole in its centre one quarter of an inch in diameter. On blowing through the hole the tube will collapse. On blowing through a metallic tube of the same size, having a similar circular piece of wood in one end, and lateral holes, the flame of a lamp will be drawn into the holes. In both these cases the current from the mouth communicates a share of its outward motion to the lateral portion of air with which it comes in contact, and being, as has been already shown, but slightly condensed, becomes more rare, when it expands to fill the tube, than the external air; which is prevented from rushing in at the end of the tubes to restore the equilibrium, by the impulse of the blast.

Experiment IV. Lateral holes were made in a cylindrical brass tube, about five inches long and three sixteenths of an inch in diameter. On blowing through the tube, strong jets *issued from* them, as in similar cases already described. To one end of the tube was then soldered, in such a manner as to offer no obstruction to currents of air, a diverging conical tube, as represented in the accompanying figure, of which the length was about eight inches; the diameter of the smaller end was of the same diameter with the cylindrical tube, and that of the larger end, one inch and a half. On blowing through this compound tube, the flame was *drawn into* lateral holes made at intervals in the conical part, and in the half of the *cylindrical* part next to it, although previously to joining the two tubes it had been blown *from all* the holes in the cylindrical one. It should seem, that in consequence of the rarefaction produced in the conical part, the air in the cylindrical part, meeting with diminished resistance to its progress, rushed forward by virtue of its elasticity and tendency to equilibrium with a velocity much greater than that with which it was expelled from the mouth, and thus became rarer and rarer as it proceeded, and more so than the external air. Analogous to this effect is the well known fact, that the addition of a diverging conical termination to a tube conveying liquids, greatly increases the discharge in the open air, though not in an exhausted receiver. If the cylindrical part of the compound tube be only one eighth of an inch in diameter, flame will not be drawn in at any part of it except very near the place of junction, nor will it be much affected in any way when held near lateral holes in the conical part, more than two or three inches from the same place; within that distance it will be drawn in.

Fig. 7.

If we conceive the conical part of the compound tube to be flattened in such a manner that the opposite sides may be plane and parallel, and to be soldered at the small end perpendicularly to the end of the tube, the interior will represent a portion of the space between the disks, (the whole of which may be considered as composed of a series of flat diverging tubes radiating from a common centre,) with the whole of the tube attached. If we blow through the tube, the results will be similar to those before described, except that lateral jets will escape from all holes in the tube, in consequence of the obstruction the blast meets with at the angle of junction.

Experiment V. Let the compound tube just described, having its cylindrical part one eighth of an inch in diameter, be adapted to a stop-cock screwed into a ground brass plate, and pass down from it into a very large open mouthed receiver. On exhausting the air to the one three hundredth part, and suddenly opening the stop-cock to readmit the air, a narrow strip of tissue paper, attached by the upper end, so as to have its lower end press against a hole in the smaller part of the diverging tube, will be *blown from* the hole. This experiment, in connection with the fact that on *blowing* through the tube, air is *drawn into* the same hole, proves that the direction, whether inward or outward, of the air that passes through lateral holes made in tubes through which air is forced, depends upon the comparative density of the internal and external air.

Experiment VI. Instead of the fixed disk, substitute a plate of tinned sheet iron about one foot square, perforated in the middle, and having a tube one quarter of an inch in diameter soldered at the same place. Drill holes in the plate one line in diameter, at various distances around the orifice, the nearest bordering on the tube itself. Having closed all but one of the holes by means of small pieces of tissue paper and gum arabic, support the plate in a horizontal position, and apply underneath a plane disk of tinned sheet iron, two inches in diameter, and having a cambric needle slightly projecting from its centre into the tube to keep it in place. On blowing through the tube with sufficient force to make the disk adhere, it may be ascertained whether air is drawn inwards or issues outwards through the open hole, by laying, *after* the blast has commenced, (at the instant it commences, for obvious reasons, there is a little puff of air outwards,) a piece of tissue paper upon the hole large enough to cover it, and having a narrow filament extending from one side for the convenience of holding it by a pair of forceps. Proceeding in this manner, I found the air drawn in at all the holes, including the one bordering on the tube itself, whose distance from the orifice did not exceed three quarters of an inch. At all the holes nearer the circumference of the disk, the air issued outwards. With a similar disk three inches in diameter, the air was found to be drawn in only to the distance of a little more than half an inch from the tube, beyond which it issued outwards. In this experiment a disk of card is objectionable on account of its soon becoming moist and warped, and care must be used not to confound the occasional adhesion of the tissue paper after it becomes moist, with the exterior atmospheric pressure. The substantial accuracy of the preceding results was verified by holding the plate in a nearly vertical position, and applying a very small flame close to the holes.

From the results I have described the following inferences seem to me incontrovertible.

1. Between the disk, there is a thin ring of rarefied air, the inner circumference of which coincides with that of the orifice of the tube, and the breadth of which, in the experiments last described, varied from a little more than a half to a little more than three quarters of an inch. The rarefaction of this ring is a compound result due to two causes. The first is the expansion of the radiating currents, as explained in the first part of this article, in consequence of their filling more and more space as they recede from the centre, which I shall call the primary rarefaction; the second is a sort of retrograde action of the primary rarefaction, by which it becomes in its turn a cause of additional rarefaction nearer the orifice of the tube, and which I shall call the secondary rarefaction. I discovered this retrograde action by means of my experiments with the compound tube, in the first of which it has been seen, that on blowing, previously to the juncture of the two parts, through the cylindrical tube, jets of air issued from lateral holes in any part, proving the air to be *condensed throughout its whole extent;* yet, on adding the conical diverging termination and blowing through the compound tube thus formed, the air became rarefied, not only in the conical part, but also in the *contiguous half of the cylindrical part*, as was shown by flame being drawn into lateral holes made in it. A similar effect must be produced in the experiment of the pneumatic paradox, with this modification, that, in consequence of the blast being arrested by the movable disk, the secondary rarefaction extends only to the orifice—not into the tube itself. In what proportion the secondary rarefaction contributes, in comparison with the primary, to the adhesion of the disks, it is impossible to decide, as they necessarily coexist, so that one cannot be produced without at the same time producing the other. The existence of the secondary rarefaction seems not to have been suspected, either by Mr. Abbot or Professor Espy, which accounts for the latter gentleman's supposing the distance from the centre at which

the air becomes "of the same density with the atmosphere," and beyond which it expands, to "be not much more than double the diameter of the tube."

2. There is, exterior to the thin ring of rarefied air and surrounding it, a thin ring of condensed air, extending to the circumference of the movable disk. This ring of condensed air is owing to the resistance of the exterior air to the egress of the radiating currents, and proves the fallacy of the idea advanced by Prof. Espy, in order to account for the maintenance of rarefaction during the continuance of the air-blast, that "the atmosphere makes no sensible resistance to the egress of a current."

The reason why the rarefaction extends to so small a distance only from the tube, is set in a clear point of view by the following experiment. Blow through a brass tube one eighth of an inch in diameter and six or eight inches long, and a common lamp may be extinguished at the distance of about two feet. Attempt to extinguish it at the same distance by blowing through a similar tube, having a conical termination, such as is described in Exp. IV, and the flame will not waver in the slightest degree, and it will be impossible to extinguish it, even when held quite near to the end of the tube. If the flame be applied close to lateral holes in the conical part, it will be drawn in at those only which are near the place of junction, and not be affected in any way at the remote ones. Hence it would appear, that the current expands as it enters the conical tube, and quickly loses its momentum by having to overcome the inertia of a continually enlarging column of air, while, in the atmosphere, it is prevented from expanding in an equal degree by surrounding pressure, and consequently moving before it a less column of air, it does not so quickly lose its momentum. The above reasoning applies equally to currents radiating from the centre of the disks, which on account of their diffusion are quickly retarded, and hence produce a rarefaction to only a small distance from the tube, and hence too are capable of producing only a slight condensation before them.

The principal results of the foregoing researches may be stated as follows: On blowing through the tube, there are, when the movable disk is placed underneath, three forces which urge it downwards—its own gravity; the impulse of the blast, weakened by striking obliquely against a somewhat conical mass of nearly stationary air; and the elasticity of the interposed air, greatly diminished by the rarefaction around the tube. On the other hand, the disk is urged upwards by the atmospheric pressure underneath, assisted, though not essentially, by the currents striking against its under surface; the latter forces preponderate, and the disk adheres.

The following modification of the experiment of the pneumatic paradox admits of easy explanation, in conformity with the principles established in this article. Condense the air strongly into a condensing chamber partly filled with water, and adjust the tube, with the perforated disk attached, to the stop-cock. On applying the movable disk and opening the stop-cock, the water is forced against the movable disk, which adheres in the same manner as when air is used. In this case the water, which, not being expansible, may be seen not to fill the whole space between the disks, carries with it a portion of the interposed air, and the rarefaction thence resulting causes the adhesion of the disks.

Most of the original experiments I have described, have been repeated with George B. Emerson, Esq. of this city, President of the Boston Society of Natural History; those which required an air-pump were performed with Prof. Lovering, by whose kindness I was permitted to make use of the very powerful instrument belonging to his department in Harvard University; and several of those undertaken to determine the truth of the proposition advanced by Bossut, were repeated with Professor Treadwell, likewise of Harvard University, to whom I am indebted for several valuable suggestions.

I feel unwilling to bring this article to a close without adding a brief tribute to the memory of the late lamented Samuel Abbot, Esq., the gentleman whose theory of the pneumatic paradox I have attempted to establish on the basis of experiment. Having been bred to the bar, he practiced his profession several years in New Hampshire, and subsequently in Massachusetts, with the reputation of being an accurate and able lawyer. Not finding it however congenial to his tastes, he relinquished it, engaged in a course of nice experiments to ascertain the practicability of advantageously making starch on a large scale from the potato, and invented the machinery and processes by which that article is now manufactured in the Northern States, to the annual amount of probably five or six million pounds. He thus originated a branch of business which affords employment to numerous individuals, which has enhanced the profits of agricultural industry and the value of real estate, in those parts of the country where it is carried on, and contributed to reduce the cost of those products of labor, in the manufacture of which potato starch is used. His mind was highly cultivated and original. He was remarkable for the accuracy, variety, extent and depth of his knowledge, and still more so for a perspicacity of intellect, which enabled him to detect error in its least suspected forms, and to perceive, with almost the quickness and certainty of intuition, truths and relations which reveal themselves to most minds of even a high order, only after patient and profound thought. What most distinguished him, however, and peculiarly endeared him to his friends, was the singular purity, elevation and benevolence of his character. It is hardly exaggeration to say, that they who knew him longest and best, recollect no feeling, word or act of his that was wrong. He seemed to be wholly free from any desire of distinction, though always active to do good, whenever and wherever he thought he could be useful. Possessing a competent fortune, he made a most liberal and generous use of it. In the words of one* qualified both by ability and from opportunity to form a right estimate of his character, "his unambitious career was bright with a daily usefulness. His life bore witness that the finest minds may find as large a sphere of usefulness in the retirements of the country, as among the crowd of a city. Few have been more beloved and respected when living, or more widely mourned when dead." He perished in a fire, January 2, 1839, in the prime of life.

Art. VII.—*On Terrestrial Magnetism;* by John Locke, M. D., of Cincinnati, Ohio.

Messrs. Editors—For three or four years past, most of the scientific men of our country have felt an interest in the examination of the elements of terrestrial magnetism on this continent. The increasing attention to the subject in Europe has operated sympathetically, and has excited a few of us to action. Professors Bache, Courtenay, Loomis, Jackson, and myself, have each devoted a portion of our time to actual surveys; the results, so

* Rev. E. Peabody, of New Bedford, Mass.

far as they have been communicated and published, are to be found mostly in the papers of the American Philosophical Society. But few of mine have yet been made public. The field is a very broad one, and the amount of labor yet to be performed is very great. As these elements are subject to a constant and progressive change, besides an annual and diurnal fluctuation, the exact laws of which are as yet unknown, time and a multiplicity of observations at each separate station are required before any generalizations can be well established.

I have this year commenced making monthly, and sometimes even hourly, observations at this place. In our money making country, I can procure little or no assistance in so unprofitable a business, and my hourly observations are almost too laborious to be continued. My friend and correspondent, Prof. Loomis, has collected together such observations as have been made, and has published them in tables and in the form of a chart in your Journal,* but so few have been the observations, and in them generally no attention paid to the annual and diurnal changes, that such a chart must necessarily be only an approximation to the truth, except at the few points which have been particularly examined. In the present volume of this Journal, pp. 49, 50, Prof. Loomis has, upon rather hypothetical grounds, marked his own observations, mine and Prof. Courtenay's, with "apparent errors," to a considerable amount. Now most readers will understand by this, that the results of the observations are absolutely out of truth, or disagree with nature to the amount noted. A careful examination of the article shows that this was not his meaning, for the standard by which these "errors" are made to appear, is more questionable than the observations themselves. Prof. Loomis, from a comparison of the most ancient with the most recent observations in our country, supposes that he has obtained the average annual decrease of the magnetical dip in the United States. He then applies this quantity as a correction to previous observations up to the present year, projects lines of "equal dip" in the direction indicated by two or more points thus determined, and by so much as late observations disagree with these calculations, he has noted them in "error." The only objection which I offer to this mode of expressing *difference*, is that it will not generally be under-

* Vide this Journal, Vol. xxxiv, p. 290, Vol. xxxix, p. 41.

stood. There is certainly no better authority for the dip at any particular time and place, than careful observations made with the best instruments. When artificial lines do not agree with observations, it is evident that those lines should be marked "*in error.*" The lines of equal dip, as obtained by actual survey, are not great circles nor uniform curves; they undulate irregularly, converging in some places and diverging in others, and sometimes, I believe, one line of equal dip will divide into two which will afterwards reunite. It is perhaps customary with those who make magnetical charts, to endeavor to equalize these natural irregularities, as the engineer after a survey for a road equalizes the hills and hollows to obtain a less devious but more artificial surface. Such a line, although it is easily projected, and looks well in the chart, has no existence in nature, and is only an artificial approximation to truth; so far as it departs from the results of actual observations, the line itself should be marked in error, not the observations. This, I say, would be philosophical; a conventional mode of expressing the same relation in different terms may obtain a preference, and would be unobjectionable provided it should be properly understood.

The largest number of my magnetical experiments were made in Iowa and Wisconsin Territories during last autumn, and the general results, including both the dip and intensity, have been communicated both to Congress and to the American Philosophical Society. But I am reminded by the above suggestions that I ought to lay before the public a specimen of the details at large, that a proper judgment may be formed of the degree of credit to which they are entitled. I shall confine myself at present to that part of my observations for determining the dip. My dipping compass was made by Robinson, of London, in 1837. As a check upon errors, I make at each station, by means of two separate needles, a double suite of observations. In each suite, all of the usual reversals are made, including the face of the instrument, the face of the needle, and the polarity of the needle by retouching. The dip is therefore determined by eight distinct readings of each needle, the two results almost always agreeing within one or two minutes of a degree. The mean of the whole of the sixteen readings is finally taken. The following are examples:

No. 1. *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°05′	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)574 16			8)575 20
		Mean, 71 48.25			Mean, 71 55

No. 2. *Davenport, Iowa Territory, Sept.* 18, 1839.

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.	73°05′	E.	E.	72°18′
W.	W.	70 43	W.	W.	71 26
W.	E.	72 51	W.	E.	72 14
E.	W.	70 40	E.	W.	71 25
A North.			B North.		
E.	E.	70 57	E.	E.	71 41
W.	W.	73 14	W.	W.	72 19
W.	E.	70 50	W.	E.	71 30
E.	W.	73 04	E.	W.	72 27
		8)575 24			8)575 20
		Mean, 71 55.5			Mean, 71 55

No. 3. *Lost Grove, (Iowa,) Sept.* 23, 1839. *Lat.* 41° 39′ *N.*, *Lon.* 90° 09′ *W.*

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.	71°07′	E.	E.	71°43′
W.	W.	73 16	W.	W.	72 36
W.	E.	70 56	W.	E.	71 45
E.	W.	73 19	E.	W.	72 39
B North.			A North.		
E.	E.	72 59	E.	E.	72 11
W.	W.	70 50	W.	W.	71 34
W.	E.	73 01	W.	E.	72 05
E.	W.	70 54	E.	W.	71 44
		8)576 22			8)576 17
		Mean, 72 02.75			Mean, 72 02.125

No. 4. *Wapsipinnicon River*, *Sept.* 25, 1839. *Lat.* 41° 45′ *N.*, *Lon.* 90° 23′ *W.*

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.	73°16′	E.	E.	72°23′
W.	W.	71 07	W.	W.	71 48
W.	E.	73 17	W.	E.	72 18
E.	W.	71 10	E.	W.	71 57
A North.			B North.		
E.	E.	71 15	E.	E.	72 15
W.	W.	73 20	W.	W.	72 27
W.	E.	71 10	W.	E.	72 12
E.	W.	73 27	E.	W.	72 37
		8)578 02			8)577 57
		Mean, 72 15.25			Mean, 72 14.625

No. 5. *Brown's Settlement*, (*Iowa*,) *Sept.* 20, 1839. *Lat.* 42° 04′ *N.*, *Lon.* 91° 02′ *W.*

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.	73°21′	E.	E.	72°25′
W.	W.	71 18	W.	W.	71 53
W.	E.	73 14	W.	E.	72 25
E.	W.	71 26	E.	W.	72 10
A North.			B North.		
E.	E.	71 26	E.	E.	72 33
W.	W.	73 22	W.	W.	72 25
W.	E.	71 19	W.	E.	72 28
E.	W.	73 32	E.	W.	72 26
		8)578 58			8)578 45
		Mean, 72 22.25			Mean, 72 20.625

No. 6. *Mahoqueta River*, (*Iowa*,) *Oct.* 1, 1839. *Lat.* 42° 14′ *N.*, *Lon.* 90° 57′ *W.*

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.	71°42′	E.	E.	72°48′
W.	W.	73 47	W.	W.	72 46
W.	E.	71 40	W.	E.	72 45
E.	W.	74 00	E.	W.	72 51
B North.			A North.		
E.	E.	73 35	E.	E.	72 52
W.	W.	71 44	W.	W.	72 25
W.	E.	73 39	W.	E.	72 44
E.	W.	71 45	E.	W.	72 35
		8)581 52			8)581 46
		Mean, 72 44			Mean, 72 43.25

No. 7. *Farmer's Creek, (Iowa,) Oct.* 5, 1839. *Lat.* 42° 13′ *N., Lon.* 90° 23′ *W.*

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°27′	E.	E.	72°15′
W.	W.	73 24	W.	W.	72 36
W.	E.	71 26	W.	E.	72 16
E.	W.	73 22	E.	W.	72 36
	A North.			B North.	
E.	E.	73 44	E.	E.	72 43
W.	W.	71 42	W.	W.	72 37
W.	E.	73 51	W.	E.	72 47
E.	W.	71 30	E.	W.	72 33
		8)580 26			8)580 23
		Mean, 72 33.25			Mean, 72 32.875

No. 8. *Prairie du Chien, W. T., Oct.* 24, 1839. *Lat.* 43° 03′ *N., Lon.* 90° 52′ *W.*

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.	72°25′	E.	E.	73°25′
W.	W.	74 17	W.	W.	73 22
W.	E.	72 05	W.	E.	73 21
E.	W.	74 32	E.	W.	73 25
	B North.			A North.	
E.	E.	74 33	E.	E.	73 26.5
W.	W.	71 53	W.	W.	73 02
W.	E.	74 24	W.	E.	73 14.5
E.	W.	72 02	E.	W.	72 58.5
		8)586 11			8)586 14.5
		Mean, 73 16.375			Mean, 73 16.875

No. 9. *Blue Mounds, (W. T.) Oct.* 30, 1839. *Lat.* 43° 01′ *N., Lon.* 89° 38′ *W.*

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.	74°59′	E.	E.	73°43′
W.	W.	72 14	W.	W.	73 22.5
W.	E.	74 47.5	W.	E.	73 42
E.	W.	72 21	E.	W.	73 31.5
	A North.			B North.	
E.	E.	73 08.5	E.	E.	73 48
W.	W.	74 21.5	W.	W.	73 46
W.	E.	73 03	W.	E.	73 40
E.	W.	74 35	E.	W.	73 52.5
		8)589 29.5			8)589 25.5
		Mean, 73 41.2			Mean, 73 40.6875

No. 10. *Madison,* (*W. T.*) *Nov.* 2, 1839. *Lat.* 43° 05′ *N.*, *Lon.* 89° 06′ *W.*

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.	73°28′	E.	E.	74°11′.5
W.	W.	74 49	W.	W.	74 11
W.	E.	73 24	W.	E.	74 01.5
E.	W.	74 56	E.	W.	74 16.5
	B North.			A North.	
E.	E.	74 59	E.	E.	74 12
W.	W.	73 00	W.	W.	73 47
W.	E.	75 02.5	W.	E.	74 02
E.	W.	72 47	E.	W.	73 49.5
		8)592 25.5			8)592 31
		Mean, 74 03.1275			Mean, 74 03.875

No. 11. *Mineral Point,* (*W. T.*) *Nov.* 1839. *Lat.* 42° 50′ *N.*, *Lon.* 89° 54′ *W.*

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.	74°30′	E.	E.	73°26′.5
W.	W.	72 10.5	W.	W.	73 09
W.	E.	74 22	W.	E.	73 18.5
E.	W.	72 22.5	E.	W.	73 12.5
	A North.			B North.	
E.	E.	72 31.5	E.	E.	73 33.5
W.	W.	74 10	W.	W.	73 15
W.	E.	72 12.5	W.	E.	73 27.5
E.	W.	74 26.5	E.	W.	73 21.5
		8)586 45.5			8)586 44
		Mean, 73 20.6875			Mean, 73 20.5

The above specimens of my field notes are not selected, but are taken in course from one to seven. Those which follow are also in course, and have been selected because they differ from what would be expected from the projections of isoclinal lines. The evidence of the accuracy of the observations rests chiefly on the very close agreement of the independent result obtained by the two separate needles. It will be seen that out of the eleven cases above quoted, there is but one in which the difference is over a fraction of one minute of a degree, and that is the fifth, which shows a difference of one minute and five eighths of a minute. If there were a certain latitude of error, say five minutes, it is evident, by the calculation of chances, that such error between the two needles, would as often be doubled by being, the one plus and the other minus, as it would be merged by both being plus or both minus; and hence half of the greatest difference by the two needles may be taken as the limit of instrumental errors, which in the above observations would be only 0′.8625 of a minute; a quantity much smaller than I should have anticipated before making the examination. The instrument is evidently a very perfect one, yet at certain points, when the dip arrives at a particular quantity, probably from a want of perfect roundness of the pivots, one needle will read constantly and uniformly more than the other. Thus at Dubuque, where the dip is 73° 04′, needle No. 1, read in the mean, constantly 2½′ more than No. 2. Even this error would ordinarily be considered very small. The French have a saying that "the dipping compass is one very ungrateful instrument." But with this fine piece of workmanship of Robinson's, I have repeatedly admired the beautiful manner in which the reversals correct all of the errors, and the two needles, none of whose individual readings are alike, will ultimately in the mean, give almost identical results.

In my surveys, I did not expect the dip to be so little at Prairie du Chien, nor so great at Madison, Wisconsin Territory, as I found it. I went through with four suits of observations at the former place, before I was satisfied of their correctness. But all of the observations between Prairie du Chien and the four lakes, agree in determining that the lines of equal dip along the Wisconsin river, in advancing westward, incline rapidly to the north. From a point about five miles south of Mineral Point, the line of dip for 73° 16′ passes to Prairie du Chien, in the direction of west 22° 10′ north. The curvature between Madison and Blue Mounds, is probably still more to the north. At Dubuque, however, there was no evidence of such a northern inclination of the lines of equal dip. At Columbus, Ohio, the dip appeared to be so much less than I expected, that after determining it twice at our station, suspecting local attraction, I removed to another a mile distant, but the result was still the same. At the very points marked by Prof. Loomis, I anticipated the departure of the magnetical quantities from their general direction, and was especially cautious in my examinations, but finally was compelled to record their results in obedience to the authority of nature. I believe there are so many anomalies in the elements of terrestrial magnetism, that the only safe way in proceeding with our surveys, is to observe industriously, and put down carefully, the results of experiments, without any reference to artificial lines, until we have dotted the map pretty thickly over with our records, and then see into what forms they will arrange themselves.

I have thus laid before your readers so much of my field notes as will enable them to understand in general my mode of operating, and have presented to them the evidence which convinces me that the results, at the time and place given, were accurate within at least two or three minutes of a degree. By this means I hope to inspire that confidence which alone gives interest to such researches. The papers of Prof. Loomis are well calculated to draw popular attention to this very interesting subject, and we hope that a science which has been considered of sufficient importance in foreign countries to induce their governments to erect observatories, supply them with instruments and observers, and even to fit out naval expeditions to explore distant regions for the advancement of its interests, will not soon be neglected by its few votaries in this country, or be so far overlooked by the great body of our community, that all encouragement to its cultivation will be withheld.

Here I had intended to bring my remarks to a close; but on reviewing them I perceive there is a possibility that some of them may be understood as a censure upon my friend Prof. Loomis. Nothing of this kind is intended. There is no difference of opinion between him and myself as to the facts. It is merely the manner of representing a fact which has elicited the remarks. A difference exists between an artificial line and a quantity determined in fact; call the one A and the other B. The question is then merely, is it more expedient to assume A to be the standard and mark B in error, or to assume B as the standard and mark A in error? I object to the choice which Prof. Loomis has made, because it will give to most of your readers, such as are not magneticians, the impression that both Prof. Loomis, Prof. Courtenay, Capt. Sabine, myself and others, are unable to determine the dip within a very great latitude of error. But Prof. Loomis did not originate this mode of expressing the difference of the two quantities; he had the precedent established by the most able foreign magneticians. It may be that conventional authority in this case, as in numerous others, ought to prevail, and that Prof. Loomis is right in conforming to that authority. Still we hope the discussion of the subject is not without its use to a large class of readers, by making them more familiar with some of the minutiæ of an interesting and in many respects a new science, and by inspiring them with greater confidence in the degree of perfection to which magneticians have arrived in their observations. They will I hope feel more interest in the observations of Prof. Loomis himself, who is furnished with the best of instruments, not only in magnetism, but in meteorology and astronomy, and is in all of these departments an industrious and accurate observer.

Could the necessary labor be performed, such charts as would exhibit the lines of equal dip, equal variation, and equal intensity in all of their various windings, including all of the so called local influences, minutely true and faithful to nature, I believe some new generalizations would be obtained. Possibly it might appear that particular geological formations are associated with some peculiarities of magnetism. There was an indication of this kind in the survey of Iowa, to the Report of which the reader is referred. But to establish a generalization requires the concurrence of numerous instances of the same kind; the change of magnetism with a change of minerals might in a single instance be accidental.

Medical College of Ohio, at Cincinnati, July 30, 1840.

Art. VIII.—*Observations on the Shooting Stars of August 9th and 10th*, 1840; communicated by Edward C. Herrick, Rec. Sec. Conn. Acad.

In 1839, the night of the *tenth* of August appeared to be that on which the meteors of this epoch arrived at their maximum. The present being leap-year, our attention was directed more particularly to the night of the 9th, as that which would this year probably afford the greatest number. Some desultory observations were, however, as usual, made previous to this date. The evenings of August 1, 2, 3, and 4, were almost entirely overcast up to a late hour. The evening of the 5th was clear, but the moon, eight days old, considerably impaired the light of the stars. From 9h. 30m. to 10h. P. M. I noted *four* meteors, all as large as stars of the first magnitude, and three of them with trains. The direction of their paths was similar to the general course on the 9th. The evening of the 6th was overcast. The evenings of the 7th and 8th were mostly clear, yet I made no special observation, preferring to watch in the morning, but, unfortunately, the sky was too much clouded both on the mornings of the 8th and 9th. The night of the 9th was beautifully clear and serene. Mr. Francis Bradley, Mr. J. T. Hotchkiss and myself, watched most of the night, each confining his attention to a quarter of the heavens, the southern being neglected during the moon's presence. At 3 A. M. (10th) Mr. Amos Hill (who with his son had been in company with us the whole time) took charge of the southern quadrant. Our station was on the summit of the Hospital, which commands an unobstructed view of the heavens. The following is a statement of our observations; the meteors being reckoned in that quadrant in which they started.

1. *Number of Meteors noted.*

	W.	N.	E.	S.	Total.
Aug. 9th, 10h. to 11h. P. M.	15	9	16		40
" 11 " 12 "	18	19	16		53
10th, 12 " 1 A. M.	19	25	27		71
" 1 " 2 "	52	41	52		145
[At 2 A. M. the moon set.]					
10th, 2h. to 3h. A. M.	75	72	90	95	332
" 3 " $3\frac{1}{2}$ "	47	35	36	59	177
					818

Three observers can not generally detect more than three fourths of the meteors which would be seen by *four;* and four observers are certainly insufficient to secure the whole. Brilliant meteors may undoubtedly be seen through half the heavens, but we have often found that many of the fainter class pass unnoticed if the observer is not looking within ten degrees of their path. Until a few minutes before setting, the moon's light must have concealed from our view about half the meteors which actually fell. Taking these circumstances into account, it can not be reasonably doubted that if the moon had been absent, more than 1500 shooting stars would have been visible at this place between 10 P. M. of the 9th and 4 A. M. of the 10th. The average number of these meteors visible to four observers during the like space of time at ordinary seasons may be taken at about 250, so that we may safely conclude that on the night of the 9th and 10th August, 1840, shooting stars were here *at least six times as numerous as usual.*

2. *Place of the radiant.* A large majority of the meteors moved, as is usual on these occasions, in paths which were doubtless nearly parallel. Their visible tracks appeared to us to diverge from a region about the cluster in the sword-handle of Perseus, but it was not easy to determine within three or four degrees the centre of this region. To make this determination with much precision, the track of each meteor must be noted on a star-chart, as has in several instances been done by observers in Europe. This we could not conveniently do without numerous assistants. According to observations made at the Königsberg Observatory, Aug. 10 and 11, 1839, (Astr. Nach. No. 385, p. 1,) the point of divergence was then near the head of Perseus, which differs scarcely at all from the determination made here. The observations made at Breslau, in August, 1839, by a corps of fifteen observers, (see this Journ. Vol. xxxviii, p. 203,) would furnish ample materials for settling the place of the radiant with all the precision of which the case admits. The general apparent course of the meteors must have been towards a point little west of south.

3. *Time of maximum.* The determination of the time of the night at which the meteors are most numerous is an important element in ascertaining the direction of the "meteoric stream." The observations of the present year agree with what appeared most probable from the observations made in this country last year, that the maximum occurs after three o'clock in the morning. This agrees nearly with the results of observations made by M. Colla and others, at Parma, in Italy, on the 9th and 10th of Aug. 1839, (Bull. Acad. de Brux. vi: 9, p. 11,) but other European observers have reported the meteors of the August epoch no less abundant before than after midnight. I can not doubt that in this country at least, and probably throughout the northern hemisphere, the meteors of this season are most numerous as late as three in the morning.

4. *Apparent sizes, colors, &c.* We kept no account of the apparent sizes of the meteors, and can only say, in general, that as many as 50 equaled the planet Jupiter, and a few surpassed it in splendor, and about 200 were equal or superior to stars of the

first magnitude. Very many left trains behind them. The *color* of the majority was the usual phosphoric white, but frequently with a tinge of red. Of the whole number there was but one which seemed to explode. The larger meteors generally vanished when at their brightest. The *times of flight* varied from about a tenth of a second to about two seconds; the majority being certainly not more than three fourths of a second. In all these characters, the meteors of the seasons of abundance, appear not to differ materially from those of other periods of the year.

5. *Zodiacal Light.* Soon after the moon had set, (2 A. M. 10th,) I noticed a faint light lying along the northern horizon, chiefly on the east of the north point, and extending upwards about five degrees. By 3 o'clock, the familiar appearance of the Zodiacal Light was distinctly visible in the northeast. It was nearly as conspicuous as we commonly see it in October. The stars Castor and Pollux were near its brightest part, from which it stretched obliquely upwards in a triangular form about as far as Aldebaran, its base blending with the horizontal light lying along the horizon a little east of north.

Having had occasion since March, 1837, to observe the northern portion of the heavens every evening, in order to ascertain the presence or absence of the Aurora Borealis, I was in the summer months much perplexed with what appeared to be a faint Auroral illumination in the north and a little west of north. This light was on favorable occasions at that season, so constant, that I was at first inclined to conclude that there is in summer a continual Aurora Borealis. After a while, I was disposed to believe that this appearance might be the Zodiacal Light. On the 16th of July, 1839, when, in company with Messrs. Bush and Haile, I watched until 2 A. M. and found that after midnight this faint luminous appearance could not be discerned west of north, but was evidently visible on the eastern side, I could scarcely doubt that my last opinion was well founded. During the present summer I have, in company with others, seen this appearance west of north as late as 10 P. M.; but, not having looked in the morning, had not noticed it after midnight until the morning of the 10th.

Although it is not established what relation there is between the Zodiacal Light and the periodical return of meteors, yet the connection between them traced by Professor Olmsted, seems to render it proper to make the preceding statement in this place.

The night of Monday, the 10th, was clear, but as the light of the moon, nearly full, rendered observation exceedingly irksome, we watched only so far as to make sure that meteors were less abundant than on the preceding night. Mr. A. B. Haile and myself watched from 10h. to 11h. P. M. and saw in the N. E. *six* meteors, and in the N. W. *seven*. From the observations of a person who was out about 3 A. M. (11th,) I inferred that the number at that time was not far from 200 an hour. The nights of the 11th, 12th and 13th were overcast,—the first up to midnight, and the others until morning.

Observations at Jamaica, L. I., 9 *miles E. New York City.*

The following particulars have been communicated to me by my friend, Mr. George C. Schaeffer. "About the first of August, the majority of several bright meteors which I saw, seemed to indicate a common radiant. I also received a note from a friend who had his attention attracted by several brilliant meteors between 11 and 12 o'clock on the 2d inst. They were apparently not much more numerous than usual, but appear to have radiated from a common point.

"On the evening of Saturday, the 8th, I saw nothing remarkable, but about 3 A. M. (9th,) I saw five or six meteors within a few minutes, but watched some time longer without seeing more. On the evening of the 9th, I saw several, although the moon was very bright. When the moon was about setting, I found the number of meteors was considerable, and from about 2h. 15m. A. M. (10th,) I kept a sharp lookout, with an intermission only of about five minutes, directing my attention towards Cassiopeia. During the hour from 2h. 15m. to 3h. 15m. I counted *sixty seven* meteors, and in the next half hour I counted *thirty eight*, and in all until I retired, (about 4h. A. M.,) *one hundred and twelve.* It will be seen that notwithstanding the light of day, the number was on the increase during the last half hour. Most of the meteors were above the *second* magnitude; some were very bright and left trains; few were very small, and still fewer were nonconformists. I was struck by one peculiarity which continued during the night,—the appearance of four or five meteors in rapid succession, and then a considerable pause. The point (or rather the centre of the region) of radiation, carefully observed, was at 3 A. M. a little south of a point *one third* of the distance from ε to ι Cassiopeiæ, or about 30° R. A., 63° or 64° N. Dec. A few meteors very near this point seemed to indicate it pretty fairly. Of the small number of nonconforming meteors that I saw, nearly all had one identical path, intersecting the milky way at right angles about midway between Cassiopeia and Deneb. Of the whole number visible I am quite certain that I could not see more than one fifth part. I am confirmed in my opinion by the fact that another person in directing attention to the same quarter, detected in two or three minutes, several more than I saw.

"The evening of Monday, (10th,) with a still brighter moon, showed only a few meteors; but after the moon had set, a little after 3 A. M. (11th,) I saw *thirty five* in as many minutes, a much larger proportion being brilliant than on the morning previous. The dawn again interfered. The radiant point had shifted from last night's position, but I could not determine it exactly. On both these mornings the *Zodiacal Light* was bright, and extended, as I thought, to a point between the Hyades and Pleiades.

"Thus you will see that on the morning of the 10th August, 1840, meteors appeared at the rate of from 330 to 400 per hour, and on the morning of the 11th, at the rate of at least 300 per hour. This gives us a fair shower, and I trust it has been generally observed. I find on comparing this year's observations with those I made two years ago, that we are at least approximating to the place of the radiant."

Philadelphia, Pa. "The August period of the return of the shower of meteors came round last evening, the 9th, this year being leap year. Notwithstanding the brightness of the moon, nearly full, the display began early in the evening, and continued till late in the morning. Many of the meteors were as bright as Venus. They all moved, with few exceptions, in directions which, being extended backward, would pass through the head of Perseus, which continued for several hours to be the radiant point. Some brilliant meteors were also seen on the evening of the 8th inst. The circumstance of these meteors radiating from the head of Perseus, was noticed on the 9th, 10th and 11th of August, last year, at several observatories in Europe, where their directions were measured with much care and precision, particularly at Bessel's Observatory in Königsberg."—*Philad. Gazette, August* 10, 1840.

Some other meteoric periods.

It seems quite probable that the months of June, October and January, (the dates first named at p. 366, Vol. xxxv, among possible meteoric seasons,) will each furnish a period at which shooting stars may be seen, either annually or occasionally, in uncommon frequency. The following is the evidence in regard to the date last referred to,—the morning of the *second of January.*

1. At the conclusion of a description of a singular meteor seen about 5 A. M. January 2, 1825, between S. Giovanni and Montevarchi, in Tuscany, M. Antonio Brucalassi, the observer, adds,—"The night during which this meteor appeared, was clear, calm, and very cold. Before and after its appearance, the atmosphere was traversed by a multitude of the luminous bodies known by the name of falling stars."—*Antologia, Feb.* 1825, *p.* 135, quoted in *Ferussac's Bull. Univ., Math. Phys., etc.* iii, 328.

2. I have been informed, but not directly, that a person at this place, (New Haven,) saw an unusual number of meteors before daylight on the morning of the first of January, 1839.

3 and 4. M. L. F. Wartmann, of Geneva, in a paper on the meteors of August 10 and 11, 1838, (*Corresp. Math. et Phys. de M. Quetelet, Bruxelles, Juillet,* 1839,) states the following:—"M. Reynier has informed me that on the 2d of January, 1838, at 3 o'clock in the morning, there was seen at Planchettes and at La Chaux-de-Fonds, (Switzerland,) an unusual display of shooting stars. I may add that a similar phenomenon was observed at Mornex, near Geneva, on the 2d of January, 1835, from 4 A. M. until daylight." p. 351.

The testimony which can be adduced in support of a meteoric period in June, seems no less strong than that given above in regard to January, yet it does not appear certain on what day of the month the maximum falls. The data now in hand indicate the period from the 15th to the 20th; but this must be determined by future observation. The precise date of the greatest meteoric frequency in October is still less definitely known, but it will in all probability be found to occur between the 8th and 25th of the month.

New Haven, Conn., August 28, 1840.

Art. IX.—*Earthquake in Connecticut, &c.*

On Sunday, August 9, 1840, a shock of an earthquake was distinctly perceived in many parts of Connecticut, and at Hartford was so severe as to cause considerable alarm, especially in the churches in which many people were assembled, and out of one of them they rushed with precipitation.

"In New Haven it was not perceived at all by the people assembled in the churches, and the trembling was slightly felt by one or two persons in their own dwellings. In one house two persons lying down were aroused by the shaking of the bed and the rattling of the window blinds; the house is of brick. At North Milford, six miles west of New Haven, it was not perceived. At Milford, still further west, and at Bridgeport, it was felt and heard distinctly. Hence we hear of it to the north and northeast, as very distinct in a part at least of Derby, in Waterbury, Middlebury and Woodbury, nine to twenty five miles from New Haven; and still more distinctly, it is reported, in Washington, yet in Watertown it was not noticed at all. Further north, we trace it through Farmington and Simsbury, ten and fifteen miles from Hartford. The report is, that it was not observed in Hartland and other towns in the north of Litchfield county. It was very perceptible in some parts of Massachusetts—not at all in Westfield. In Worcester county it was severe. In Boston there was nothing of it. It extended into Tolland county, in this State. Between Hartford and New Haven, it was severely felt in Meriden, not at all in Wallingford, nor we believe at Berlin. At Middletown there was a slight shock. From most of these places we have our information direct, yet it is probable that in some cases in which our informant had not noticed it or heard of it, it may have been perceived by others in the neighborhood.

"The noise was thought by some to proceed from east to west, and by others from northeast to southwest.

"We learn also that the shock was noticed distinctly at Clinton, about twenty five miles east of New Haven, also at Woodbridge and Wolcott. The noise is compared by different persons to the roll of thunder, the rumbling of a carriage, and the roar of a chimney on fire."*

* Hartford and New Haven Congregational Observer.

Some persons have been disposed to attribute this earthquake to the explosion of a meteor. It is true that the explosion of meteors does sometimes produce this effect, as happened Feb. 2, 1766, in Rhode Island and Massachusetts, and at Charleston, South Carolina, in November of the same year, and remarkably at Weston, Connecticut, December, 1807. But there is in the present case no distinct evidence of the transit of a meteor, no such body having been observed,* nor have any fragments been reported as having fallen from the atmosphere.

The great seat of American earthquakes being on the western side of the continent, comparatively few events of this nature have been observed on the eastern side since Europeans have become acquainted with the western hemisphere.

An interesting account of the earthquakes of New England was given to the American Academy of Boston by Prof. Williams, in the volume of their Transactions for 1785, and the remarkable facts described in it might well form the subject of a distinct notice, for which we have not now room. What we have at our disposition shall be devoted to a scene of local disturbance in Connecticut which has been observed ever since the settlement of the country. The region is around East Haddam, on the Connecticut river, a few miles below Middletown. The following memorandum was by request communicated to the senior editor of this Journal twenty five years ago, by the late Rev. Henry Chapman,† and it has been kept on file with the expectation of making an investigation on the spot; but, as that which has been so long delayed may never be done, we are induced to give the fragment on the present occasion.

"In attempting to give an account of the circumstances attendant on subterranean noises, so frequently heard at East Haddam, perhaps it may be proper to mention the common opinion respecting them.

"East Haddam was called by the natives Morehemoodus, or *place of noises*, and a numerous tribe of cannibals resided there. They were famous for worshipping the evil spirit, to appease his wrath. Their account of the occasion of the noises is, 'that the Indian god was angry because the English god intruded upon

* The atmosphere was clear, and the sun shining bright, which might have rendered a fiery meteor invisible, unless its ignition had been very intense.

† Who died in Arkansaw, as a missionary.

him, and those were the expressions of his displeasure.' Hence it has been imagined that they originated after the arrival of the English in this country.

"About fifty years ago, an European by the name of Steele came into the place and boarded in the family of a Mr. Knowlton for a short period. He was a man of intelligence, and supposed to be in disguise. He told Mr. Knowlton in confidence, that he had discovered the place of a fossil which he called a carbuncle, and that he should be able to procure it in a few days. Accordingly, he soon after brought home a white round substance resembling a stone in the light, but became remarkably luminous in the dark. It was his practice to labor after his mineral in the night season. The night on which he procured it he secreted it in Mr. K.'s cellar, which was without windows, yet its illuminating power was so great that the house appeared to be on fire, and was seen at a great distance. The next morning he enclosed it in sheet lead, and departed for Europe, and has never since been heard of. It is rumored that he was murdered on his way by the ship's crew. He said that this substance was the cause of the noises—that a change of temperature collects the moistness of the atmosphere, which causes an explosion.

"He further observed, that there would be no more noises for twelve or fifteen years, and then they would be heard again in consequence of the explosion of some small pieces of this substance which he had left, which would by that time become sufficiently large to produce the effect. It is reported that his prediction was strikingly fulfilled. These circumstances are currently reported, and as they are recollected and often spoken of by many respectable old people, they are generally believed.

"Perhaps these stories may only serve as instances of public credulity, but as they are in the mouth of every one who says any thing about this subject, I thought it might not be improper briefly to communicate them.*

"These shocks are generally perceived in the neighboring towns, and sometimes at a great distance. They begin with a trembling of the earth, and a rumbling noise nearly resembling the discharge of very heavy cannon at a distance. Sometimes

* It is almost unnecessary to say, that these foolish stories are deserving of no credit whatever, and they are here preserved only as a part of the legends of the day.—Eds.

three or four follow each other in quick succession, and in this case the first is generally the most powerful.

"While I was pursuing my inquiries concerning this subject, I was so fortunate as to find a register, in which was recorded a collection of observations on the state and changes of the atmosphere, the tides, and in short the most remarkable occurrences of the last thirty years, which were noted at the time, with some of the attendant circumstances. From this I copied in short notes an account of the Moodus noises since that period, which I here subjoin in detail.

"The first which was recorded occurred on the 16th of May, 1791. It began at 8 o'clock, P. M. with two very heavy shocks in quick succession. The first was the most powerful; the earth appeared to undergo very violent convulsions. The stone walls were shaken down, chimnies were untopped, doors which were latched were thrown open, and a fissure in the ground of several rods in extent was afterwards discovered. Thirty lighter ones succeeded in a short time, and upwards of one hundred were counted in the course of the night.

"This shock was felt at a great distance. It was so severe at Killingworth, (about twenty miles distant,) that a Capt. Benedict, who was walking the deck of his vessel, then lying in the harbor of that place, observed the fish to leap out of water in every direction as far as his eye could reach.

"The atmosphere was perfectly clear and pleasant, and the moon, which was near its full, shone remarkably bright. On the night of the 17th, six more were observed. The atmosphere was still clear and warm.

"The next occurred August 28th, 1792, at 10 o'clock, P. M. Rain in the forenoon, wind at the eastward. In the afternoon the wind was southwest. Warm and somewhat squally.

"October 24th, 1792, at 1 o'clock in the morning, occurred three shocks. Very pleasant weather—wind southwest.

"Another was observed on the 11th of January, 1793, at 8 o'clock, A. M. The weather was very pleasant and warm. It thawed.

"There was another on the 6th of July, at 6 o'clock in the morning. Very warm and damp. Rain with thunder in the afternoon.

"March 9th, 1794, at 2 o'clock, P. M. there were two, and a third at 11 o'clock, P. M. The atmosphere was clear in the morning, hazy and damp in the afternoon.

"Two others were observed on the 11th of August, 1805, at 7 o'clock, P. M. Wind southwest in the forenoon, and a thunder storm about 4 o'clock, P. M.

"Another occurred on the 30th December, at 6 o'clock, A. M. The atmosphere was moist.

"There were two others on the 9th of February, 1812, at 9 o'clock in the forenoon. Weather was clear, and the wind southerly.

"Another was observed on the 5th of July, at 8 o'clock in the forenoon. The atmosphere was filled with rain and mist.

"The last was on December 28th, 1813, at 4 o'clock in the afternoon. The weather was damp, and thawed the snow fast.

"This account has been several times interrupted by the ill health of the gentleman who kept it. These periods have been frequently of considerable length, and in all probability in these intervals many of these occurrences were omitted.

"The particular place where these explosions originate, has not been ascertained. It appears to be near the northwest corner of the town. It was near this place that Steele found his fossil. The place where the ground was broken when the first one occurred which I mentioned above, was about three and a half miles from this place. There was no appearance of a deposit near where the ground was broken, but it has been observed that this place has been repeatedly struck with lightning.

"The above is the amount of the information which I collected on this subject. I am conscious of the insignificance of some of it; but these stories were blended with all the virtual information which I could find. For this reason I have written them."

The Haddam earthquakes were described more than a century ago by the Rev. Mr. Hosmer, of Haddam, in a letter to Mr. Prince, of Boston, dated Aug. 13, 1729, and recorded in Trumbull's History of Connecticut, (Vol. II, p. 92,) from which the following passages are extracted: they have the tinge of the times, which only adds to their credibility.

"As to the earthquakes," he observes, "I have something considerable and awful to tell you. Earthquakes have been here, (and no where but in this precinct, as can be discerned; that is, they seem to have their centre, rise and origin among us,) as has been observed for more than thirty years. I have been informed, that in this place, before the English settlements, there were great numbers of Indian inhabitants, and that it was a place of extraordinary *Indian pawaws*, or in short, that it was a place where the Indians drove a prodigious trade at worshipping the devil. Also I was informed, that, many years past, an old Indian was asked what was the reason of the noises in this place? To which he replied, that the Indian's God was very angry because Englishman's God was come here.

"Now whether there be any thing diabolical in these things, I know not; but this I know, that God Almighty is to be seen and trembled at, in what has been often heard among us. Whether it be fire or air distressed in the subterraneous caverns of the earth, cannot be known; for there is no eruption, no explosion perceptible, but by sounds and tremors, which sometimes are very fearful and dreadful. I have myself heard eight or ten sounds successively, and imitating small arms, in the space of five minutes. I have, I suppose, heard several hundreds of them within twenty years; some more, some less terrible. Sometimes we have heard them almost every day, and great numbers of them in the space of a year. Oftentimes I have observed them to be coming down from the north, imitating slow thunder, until the sound came near or right under, and then there seemed to be a breaking like the noise of a cannon shot, or severe thunder, which shakes the houses and all that is in them. They have in a manner ceased, since the great earthquake. As I remember, there have been but two heard since that time, and those but moderate."

Dr. Trumbull, without giving an exact date, goes on to remark in his history: "A worthy gentleman, about six years since, gave the following account of them."*—"The awful noises, of which Mr. Hosmer gave an account, in his historical minutes, and concerning which you desire further information, continue to the present time. The effects they produce, are various as the intermediate degrees between the roar of a cannon and the noise of a pistol.

* As the venerable historian placed the MS. of his second volume confidentially in the hands of the senior editor of this Journal in the year 1810, the letter alluded to above must have been written about the beginning of the present century.

The concussions of the earth, made at the same time, are as much diversified as the sounds in the air. The shock they give to a dwelling house, is the same as the falling of logs on the floor. The smaller shocks produced no emotions of terror or fear in the minds of the inhabitants. They are spoken of as usual occurrences, and are called Moodus noises. But when they are so violent as to be heard in the adjacent towns, they are called earthquakes. During my residence here, which has been almost thirty-six years, I have invariably observed, after some of the most violent of these shocks, that an account has been published in the newspapers, of a small shock of an earthquake, at New London and Hartford. Nor do I believe, in all that period, there has been an account published of an earthquake in Connecticut, which was not far more violent here than in any other place. By recurring to the newspapers, you will find, that an earthquake was noticed on the 18th May, 1791, about 10 o'clock, P. M. It was perceived as far distant as Boston and New York. A few minutes after there was another shock, which was perceptible at the distance of seventy miles. Here, at that time, the concussion of the earth, and the roaring of the atmosphere, were most tremendous. Consternation and dread filled every house. Many chimnies were untopped and walls thrown down. It was a night much to be remembered; for besides the two shocks which were noticed at a distance, during the night there was here a succession of shocks, to the number of twenty, perhaps thirty; the effects of which, like all others, decreased in every direction, in proportion to the distances. The next day, stones of several tons weight, were found removed from their places; and apertures in the earth, and fissures in immovable rocks, ascertained where the explosions were made. Since that time the noises and shocks have been less frequent than before; though not a year passes over us but some of them are perceptible."

It appears that the earthquake was perceived at Middle Haddam on the present occasion. The country in that region is of granite, gneiss, and other primary rocks, and has during many years been famous for its fine crystallized minerals,—beryl and emerald, chrysoberyl, tourmaline, garnet, columbite, &c. Its numerous quarries afford the most magnificent slabs of hornblende gneiss for pavements, and supply distant parts of the United States; and porcelain feldspar has been obtained there by hundreds of tons for exportation. A few miles above, (north,) the primary changes to red sandstone, with trap; and near this junction is a lead mine, formerly wrought, but now abandoned. A trap dyke of vast extent intersects the country, running from the coast at Guilford a great way inland.

In Middle Haddam, near the centre of the well known Moodus noises, "the shock was quite severe." The direction was thought to be from west to east, but not exactly in a line with the stratification of the country. The above remark is quoted from an observer by the Rev. Mr. Brewer, late missionary in Smyrna.* The same gentleman adds the following facts. Being at Chester on the day of the earthquake, (August 9,) a few miles below East Haddam, on the Connecticut River, he observed the jar to be equal in violence to one half of some 15 or 20 shocks to which he had been annually accustomed for a course of years in Smyrna. He thinks that the rumbling may have continued half a minute, and that its course was from N. W. to S. E., nearly in the direction of the strata. It was perceived at Westbrook, Haddam and Wethersfield.

Mr. B. thinks that the earthquakes in Connecticut all proceed from the Moodus Hill, called Mount Tom. He observes that Smyrna was destroyed by an earthquake A. D. 177, and that the catastrophe has been several times repeated, "but generally speaking, its numerous annual earthquakes extend over a circumference of probably not more than 20 or 30 miles, and are ordinarily so slight as barely to arouse one out of sleep, and seldom if ever does any rumbling accompany the shock." "Besides their limited extent, there are hot springs about five miles from the city, under the foot of Mount Corea, which go to prove them of local origin."

Nothing has, we believe, been suggested regarding the cause of the Haddam convulsions, worthy of confidence. The old story of fermenting or decomposing pyrites has been repeated, but this cause seems quite inadequate to account for movements extending at intervals through centuries.

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* In the Hartford and New Haven Congregational Observer, of Aug. 29, 1840.

ART. X.—*A Synopsis of the Birds of North America;* by JOHN JAMES AUDUBON, F. R. SS. Lond. and Ed., &c. Edinburgh, 1839.

The Birds of America, from drawings made in the United States and their Territories; by JOHN JAMES AUDUBON, F. R. SS. Lond. and Ed., etc. Vol. I. New York, 1840.

WHEN the celebrated French naturalist, Buffon, had concluded the ornithological portion of his interesting but visionary and imaginative work on natural history, he announced with all the solemn and dogmatical assurance of even more than Gallic egotism, that he had completed the "History of the Birds of the world." The work he had just finished embraced descriptions and the history of eight hundred species of birds from different parts of the globe. Their discovery had been the work of nearly twenty centuries. Their present number seemed immense to the short-sighted votary of science; and the self-satisfied naturalist looked upon his own handiwork with ecstatic delight, and unhesitatingly pronounced it to be as nearly perfect and as complete as it was in the power of humanity to accomplish. The student of nature who now attempts to tread the mazy and perplexing labyrinth of modern ornithology, pauses with wonder and contemplates with astonishment, the blindness or contracted vision of him, who could deem a work "so nearly complete as not to admit of a material augmentation," which he now finds to contain hardly a sixteenth part of the species known to inhabit the earth. He can hardly realize, that while nearly twenty centuries on the one hand did not furnish the knowledge of one half as many hundreds of species, a single *half* century has multiplied that number almost by twenty.

Nor has this astonishing change been confined to the science of ornithology. The progress of every other of the natural sciences during the latter part of the eighteenth, and their advancement since the commencement of the nineteenth century, have been wonderful in the highest degree. Not only have all those before recognized as such received such immense augmentations and improvements as to throw their former selves very far into the shade, but even others wholly new but admitted to be distinct sciences, have been brought to light.

Botany, for instance, is no longer an overgrown accumulation of synonyms and absurdities. It no longer is deformed by the ignorance, the want of method, and the lack of fertility of invention of its historians, as it had been rendered by the followers of Linnæus. Entomology has taken rank, to which it is clearly entitled, as a distinct science. Ornithology is no longer the dry and repulsive study of uninteresting technicalities that it was in the day of the great Linnæus, nor on the other hand does it suffer from the crude and ridiculous though eloquent and attractive theories of Buffon. And, although it may not have escaped the effects of the whimsical notions of modern systematists, it is still a science, upon the study of which few can enter without deriving from it delight, instruction and improvement. Comparative anatomy is no longer a despised and neglected pursuit, but is now recognized as a distinct science, and is rapidly becoming the basis of all zoological arrangement. Ichthyology has been so changed by separation of subjects no longer embraced by it, and by more than equivalent increases, that it may almost without exaggeration be regarded as having become an entirely new science. And that most interesting, most instructive, aye, and most *profitable* of all the natural sciences, geology, has sprung at once, as it were, into light and life.

By what agency have all these surprising changes been effected? By whom have all these things been accomplished in so brief a space of time? By the munificence of what government, aided and directed by the persevering industry and intelligent investigations of what scientific associations, have these incredible changes been brought about? It seems hardly possible, and yet it is strictly true, that all this astounding revolution, effected as it has been in the short space of half a century, has been brought about with hardly any aid from the patronage of governments, and with very limited and contracted assistance from the coöperation of scientific societies. True it is, both have lent their partial and of themselves ineffectual labors in promoting this great end, but both have been but as humble instruments to set in motion a power far mightier than they. As the single spark will ignite a train of powder, and thus becomes an instrument of sufficient power, humble as it may seem of itself, to destroy whole cities, so have the feeble but well directed efforts of the friends of science, by removing the mountain of popular prejudice that was resting upon it, been enabled to awaken public opinion to the subject, and by almost a single stride to place the study of natural history in that elevated rank to which it properly belongs, but from which it had been forever before shut out by prejudices as unfounded as they were narrow and contracted.

It is not our present purpose to point out the steps by which, nor enumerate those through whose agency, this radical change in the public mind has, with unexampled rapidity, taken place; but we cannot forbear to point to one whose efforts in the cause have been preëminent, and whose success has been without example. Our readers hardly need be told we refer to George Cuvier. By his labors as a naturalist—by arranging, in a manner never before equalled, the objects of his research, by displaying at one view the wonders of the remotest ages, and of the most distant portions of the earth,—as the public lecturer who carried away with him his audience, by the variety of his illustrations, the vividness of his descriptions, and the fascination of his eloquence,—as the philosophical writer, by his powers of combination and analysis, by his classification of what was insulated, by giving system and unity to the most desultory fragments of natural science, by establishing new laws, by opening new fields of research, by throwing the light of his genius over the darkest pages of nature,—in fine, by a whole life devoted to that object, he carried away captive the intelligence of a whole people, and an almost universal acquiescence on the part of his countrymen in favor of his darling studies. The change in public opinion in favor of the natural sciences, then progressing slowly and with uncertain steps, received an impetus at his hands which carried it onward at a rapid rate, and which has since continued without intermission, and in spite of the scoffs and the sneers of the ignorant, the doubting shrug of the short-sighted, or the illiberal *cui bono* of him whose contracted vision looks only to immediate advantage, and the dimness of whose sight will not enable him to discern the remote, but not on that account less certain advantages which accrue to him who opens, in a proper spirit, the great book of nature, every page of which speaks to him so plainly of nature's great Originator.

The day has now gone by when the field naturalist, whose days are spent in roaming in search of ornithological specimens, and whose gun is his inseparable and perhaps only companion, is to be carelessly and capriciously set down by the prejudice and injustice of those who may not sympathize with his pursuits and his tastes, as a vagabond, an idler, and at best a very useless individual, if not one who should be regarded as an outcast from society. The entomologist, with his net and other paraphernalia for the pursuit of the objects of his study, has at last ceased to be looked upon except by the ignorant and the unintelligent, as at best a sort of monomaniac, who manifests his insanity by pinning all sorts of curious bugs to the crown of his hat.

The study of the natural sciences is fast becoming a more and more favorite pursuit; every hour adds to the numbers of its votaries, and its warmest friends have at length every reason to be satisfied with the progress it is making, and to feel that before long it will keep pace with that of civilization and intelligence. Beyond this would be to expect impossibilities.

The friends of the natural sciences need ask for no stronger proof of the beneficial effects which follow the study of their favorite pursuits, than that offered by the simple fact of its onward progress, and the rapidly increasing favor it finds with the public. Did these not exist, in vain might Cuvier have labored; in vain would have been all the fascinating eloquence of his lectures; in vain the simplicity and clearness of his writings. He might, indeed, for a time, have carried captive, by his powers of intellect, an imaginative people; but they would sooner or later have detected the imposture, had they been pursuing an ignis fatuus, or even a harmless but unprofitable shadow. An intelligent people may for a time be deceived and misled, but they are never long deliberately in error; and we may therefore appeal with confidence to the striking and conclusive facts that where there is most intelligence, there and there only, the natural sciences flourish best, and also that the more the attention of a people is called to the subject, the more and more popular do they become, and the greater and more universal the avidity with which their study is pursued. It is not only because they are a never failing source of delightful occupation—it is not only because their study has been found by the experience of years to convey nothing at all at variance with morality or religion—but it is moreover because of the direct and positive benefit which they are found to create both in a religious and a moral point of view, that we find their study now encouraged and sanctioned by the enlightened and the unprejudiced public.

The study of nature is but the study of the works of the Almighty. We see in every portion, whether the animalcule, or the mastodon, the products of His all-directing hand. We trace in every atom that goes to make up the whole, the undeniable evidence of his inscrutable wisdom. No wonder, therefore, that all who ever opened the book of nature, with a proper spirit, never failed to turn from its contemplation with a more devout and reverential acknowledgment of their Author's infinite wisdom, goodness, and power. No wonder, therefore, that the naturalist is seldom or never other than most seriously impressed with religious and devotional feelings. It is no wonder, limited as are the number of those whose labors in the cause of natural history have rendered them conspicuous, so large a proportion should have been preëminent for their piety,—that the Willoughbys and the Rays, the Linnæuses and the Cuviers, and a host of others, should have been as bright examples in the walks of private life, as they have since become celebrated for their writings. No wonder that we are constantly meeting in their productions, a pure spirit of religious belief breathing in all their writings, or bursts of lofty praise and enthusiastic admiration of Nature's God, breaking forth and irradiating all they ever wrote. The cold and hypocritical materialism which marked a certain school of French naturalists in the days of their revolution, forms no real exception to this rule. Their land was at the time overflowing with atheism and infidelity. They bowed in weakness before the current of popular frenzy, and in insincere attempts to palliate their unbelief they impiously attempted to pervert the book of nature, and to make it support their absurdities. But this very effort was of itself the means of defeating the end they had in view, and the unwieldy bubble burst under the pressure of truth. The fabric of French infidelity tottered and fell under the efforts of the philosophers to sustain it, and through the very weight of that which they vainly supposed would give to it symmetry and strength. Their wild conclusions disgusted by their absurdity all whom their impiety had failed to shock, and Christianity triumphed by means of the very blows that were designed for its destruction.

It is therefore impossible to come to any other conclusion than that the study of natural history must have a necessary and inevitable tendency to impress the mind with the truth of religion, and thereby to improve as well as regulate the moral feelings.

The book of nature expounds the works of Omnipotence; and what grander, what more dignified, or what more ennobling study can occupy the human mind? If, as has been well said by one of the best of English poets,

"The undevout astronomer is mad,"

what are we to think of him who contemplates—not objects, all inquiry into whose nature, is utterly futile—but, those whose properties he can distinguish, whose structure he can examine, and whose economy he can explore, without feelings of awe and wonder at the power that contrived them?

The good effects of the study of natural history in a simply moral point of view, are even more apparent, if it be possible, and more inevitable than in that of religion. That proverb is a trite one, but on that account only the more true, which tells us that idleness is the root of all evil. And how fearfully true is it that nine tenths of the immorality that pervades society, originates in the first place from a want of some occupation at least harmless, to fill up vacant time. If, therefore, the study of the natural sciences are as attractive as they have been shown to be beneficial—sufficiently so to occupy the idle hours of him who has nothing else to do, even if it conduces to nothing beyond a prevention of the effects of idleness, must necessarily exert a beneficial moral influence, apart from the religious feelings inspired. That it is thus attractive, who can doubt, that looks upon it as it is—a recreation rather than a study; a means of acquiring as well as of preserving health, and a never failing source of pleasure? Let him, if he still doubts, read the poetic and animated pages of the Wilsons and the Audubons, and other kindred spirits, and he cannot fail of being himself inspired with a love for their pursuits. It has been well remarked by Swainson, that "the tediousness of a country life is proverbial; but did we ever hear this complaint from a naturalist? Never; every man who in his walks derives interest from the works of creation, is in spirit both a naturalist and a philosopher. To him every season of the year is doubly interesting. With each succeeding month new races of animals and plants rise into existence, and become new objects for his research; these in their turn pass away, and are succeeded by others, until autumn fades into winter, and both the animal and the vegetable world sink into repose."

"Thus may our lives, exempt from public toil,
Find tongues in trees, books in the running brooks,
Sermons in stones, and good in every thing."

A very visible and decided change in the public mind in favor of the study of natural history, has taken place in this country within a very short space of time. The universal dependence of almost every one upon his own individual exertions for support, have deterred, till within a few years, nearly all from even the most partial attention to this subject. Our young men have felt that their time was too precious to be so employed. But a marked change has been taking place. The avidity with which the youth of many of our seminaries of learning are turning their attention hither is most gratifying. We hail it as a harbinger of good—as a means of doing away with a vast deal of those vicious habits into which students at colleges are but too prone to fall from sheer want of something to occupy their leisure hours, and which we cannot but believe the study of nature will supply to many. It was well remarked by one familiar with the subject, in a recent lecture before the Natural History Society of the young men of Harvard College, at their anniversary in May:

"He who loves nature, loves not revelry; artificial excitement has no fascination for him. The overflowing cup and unmeaning and dishonest game, cannot entice him. He avoids them with disgust and disdain. Fortunate indeed is it for that young man who early imbibes his taste for natural objects, and who has not been thwarted in his wishes by injudicious friends!

"Does any one doubt the influence of these studies upon the morals? I will ask him to point to me the *immoral* young man who is devotedly fond of natural history? I never knew such an one. Does he still doubt the correctness of my inferences? I will show him valued friends who once mistook their course of duty and greatly erred: examining some natural productions, they were delighted; farther examination changed their delight to wonder and astonishment; they could hardly realize that such sources of exquisite pleasure were ever within their reach. Ashamed to indulge in their previous degrading career, to associate with their former companions, they stood forth regenerated; and, with renovated health and ardent devotion, *live*, grateful worshippers of the Omnipotent.

"The day is not far distant, when the establishment of your society shall be acknowledged to have been a most happy occurrence; when it shall be looked back to as the era at which commenced a visible change in the tastes and habits of the young men, who have resorted hither, when to be one of its members will be a passport to confidence and respect. Heaven grant the time may not be long delayed ere a fountain shall flow here, whose water shall be the purer the deeper it is drawn—ere, within these consecrated walls, by the enthusiastic naturalist, shall be explained the works of the Almighty."

No one has probably contributed more towards creating and fostering a taste for nature in this country, than the justly celebrated naturalist whose works we have placed at the head of this article. His magnificent and unequalled painting created every where a great interest in the subject, which was confirmed and matured to a great extent by his adventurous and enthusiastic pursuit of his darling study, and still more by the fascinating and attractive history of those whose painting at first drew attention to them. The more the public notice was drawn to his undertaking, the more did it seem unrivalled for the boldness, almost amounting to temerity, with which it was commenced, the perseverance and untiring zeal with which it was carried on, as well as the fidelity, industry and celerity, with which it was finally completed. It became as conspicuous, as it will ever remain an enduring, monument of his enterprise and scientific acquirements. It was impossible to know any thing of the man without entertaining a high sense of his unexampled and unequalled fortitude, self-denial, and moral courage. We see in him the splendid painter of nature, her eloquent historian, and the accomplished gentleman, all united in the same person, who appeared a few years since in the capital of Scotland, an unknown and friendless stranger, of humble means, and astonished the scientific world by his proposal to publish a work on ornithology upon a scale so magnificent and stupendous, as would have deterred many a wealthier devotee of science. We follow the same individual, his object in Edinburgh accomplished, in the prosecution of his Herculean task. We find him now buffeting the repulsive waves on the inhospitable shores of Labrador, now treading the mazy and unhealthy swamps of Florida, and again ransacking the rivers and lagoons of Texas. We behold him returning with the spoils of patient and unyielding assiduity, to meet with new and unexpected obstacles, thrown in his path by the commercial crisis of the country, the loss of nearly one half of the subscribers upon whom he had depended to repay his expenditures. But we see him superior to all disasters, surmounting all obstacles, and completing in spite of them, the most magnificent work on natural history the world had ever seen. Such a man is an honor to any age and to any country, and no one can contemplate his life or his labors without feeling himself carried away by the interest they inspire ; and to this we hesitate not to attribute a large share of the pervading interest that has within a few years been created in this country in favor of the natural sciences.

The first of the works to which we propose to ask the attention of our readers, is, as its name implies, simply a synopsis of the birds of North America. It is comprised in a single duodecimo volume of about three hundred and fifty pages. The number of birds enumerated is 491. And some idea may be formed of the discoveries which have been made in this department of science within the few past years, from the fact that among them are no less than 142 birds not included in the synopsis of Bonaparte, and about one half of the whole number are not mentioned in the work of Wilson. Quite a number of these are new species, from the Rocky Mountains, the discovery of Mr. Townsend.

Mr. Audubon has adopted, very nearly, the quinary system in his arrangement, a system that finds no favor in our eyes, but which we will refer to more at length when we speak of the Ornithology itself. To each family is appended the characteristics, as well as to each genus, and to every species of bird, besides a reference to his own works and plates; wherever they have been described by any other American naturalist, the author, volume and page are given. Besides this he has added in each instance a brief but accurate, and for every essential purpose, complete scientific description of the specific marks, as well as the habitat of every species.

Just such a work as this synopsis has long been a great desideratum among our ornithologists; indeed it has been next to impossible to do without one. We are therefore somewhat surprised that, although it is now more than a year since the present work first appeared, it has never been republished in this country.

Such a work as the Synopsis can never of course be a popular one, or of any interest to one not an ornithologist. Confined as it is to the technicalities of science, and affording, as it must to the beginner, nothing to interest him, it is still as absolutely indispensable as the dictionary is to the student of a language. And although we should as soon think of placing the latter *alone* in the hands of the student, as the means of learning any unknown tongue, as we should of relying solely upon a synopsis for the study of ornithology—the one is as absolutely necessary as the other. As ornithologists are multiplying among us, in an almost geometrical ratio, the want of such a work as a cheap reprint of Mr. Audubon's, is very much felt. It is the only key that yet exists in many inextricable problems in American ornithology. Thus, for instance, the Falco lineatus of Gmelin, our common red-shouldered hawk, he would find variously described as the young or the old of the F. hyemalis, as a distinct species, etc., and he might read over the pages of Bonaparte, Wilson, Nuttall, as well as the two first volumes of Audubon's text to his larger plates, changing his mind at each authority to which he referred, and at last be utterly unable to decide amid the labyrinth of conflicting testimony. But the work before us would solve his doubts, by telling him that both were but varieties of the same bird. The same would be the case with the rough-legged hawk, which he would here find to be but one bird, although multiplied into the Falco niger, F. Sancti-Johannis, etc. And so with a large number of birds to which we have not room to refer, at the length we could wish; the confusion in which they had become entangled being such as to throw no slight obstacles in the way of him who attempts to wade through them without assistance. We would therefore, from a strong sense of the want of it, advise a cheap republication by Mr. Audubon of his Synopsis.

The remaining work is one of a much more extensive character than the other, being a full and complete history, so far as present knowledge on the subject extends, of all the known species of the birds of North America. It is designed as a republication of his great work in such a form and at so reduced a price as to render it accessible to very many who were shut out from the other, with all the additions not only of new species, but also of new facts relative to those before known, and the whole scientifically arranged. The entire work, embracing colored plates—miniatures in most instances of his large work—as well as the text incorporated with them, is published at a cost of less than a tenth part of the expense of his former publication. It is issued in numbers, each containing the plates and descriptions of five species of birds. The first volume, embraced in fourteen numbers, and consequently containing seventy species, is, thus far, all yet published. It forms, however, adequate means of judging of the character of the entire work when published. As it will, in all probability, be for years to come the standard of American ornithology, it deserves our careful consideration as a scientific work on one of the most popular of the natural sciences.

The seventy birds that are given in this volume comprise all the birds of prey, the swallows, swifts, goat suckers, and the fly catchers. These are divided in the work as follows: The vultures form the family Vulturinæ, with but one genus, Cathartes. The falcons are all included in the family Falconinæ, which is subdivided into the following genera,—polyborus, buteo, or buzzard, aquila, or eagle, haliaetus, or sea eagle, pandion, or fish-hawk, elanus, ictinia, or kite, nauclerus, or swallow-tailed hawk, falco, astur, and circus. The third family, Striginæ, embrace the six genera of owls, viz. surnia, or day owl, ulula, or night owl, strix, or screech owl, symium, or hooting owl, otus, or eared owl, and bubo, or horned owl. The goat suckers make another family, Caprimulginæ, containing the genera of caprimulgus and chordeiles, or night-hawk. To the single species of swift are devoted the fifth family, Cypselinæ, and the genus chœtura. The swallows are all embraced in the single genus hirundo, family Hirundinæ. The fly catchers, family Muscicapinæ, are divided into the four genera of milvulus, muscicapa, ptilogonys, and culicivora.

We have said that the system by which Mr. Audubon has arranged the birds of America, both in the Synopsis and the Ornithology, is one upon which we cannot bestow our humble favor. In spite of the arrogant and intolerable assumption on the part of advocates abroad, and especially of him who has so undeservedly laid claim to the title of the English Cuvier, and who pretends that no objections have or can be brought against the system, we would, in all humility, venture to suggest what to our rash but deliberate judgment appears somewhat in the light of one radical defect in the system, to go no farther ; enough in our estimation to render it worse than no system at all. We mean the idle, unnecessary, and, especially to the beginner, most perplexing subdivisions into new genera. We might quote the language of the naturalist himself to whom we refer, were it necessary, to prove the evils of this needless multiplication of new genera. But they are too apparent of themselves to require the equivocal weight of his authority. We appeal to the very work before us in evidence of the validity of our objections. No portion of the feathered tribe is more strongly marked in their characteristics than the birds of prey. It is in them therefore that the folly of the fashionable subdivisions of the present day are most conspicuous. The different kinds of these birds are so well marked by the hand of nature, that the rudest and most unskilled observer can at once distinguish them and separate them into their three *natural* genera of owls, hawks, and vultures. Why mystify, then, what is in itself so simple? What is to be gained by manufacturing genera where no generic characters exist on the surface? Certainly nothing to simplify, nothing to benefit science. A falcon is still a falcon, no matter whether it have the compact form, the talons and beak of an eagle—whether it have a swallow-tail, a wing longer than tail, a collar round its neck, or whatever *specific* difference may exist. Why then, where nature has given us but one genus, and that one as distinctly defined as any in the animal kingdom, create twenty others from mere *specific* characteristics? Twenty three American hawks, and nearly half as many genera! And if we are to have a genus for nearly every species that may differ from the genus to which it *naturally* belongs, why is not the principle carried out every where? Why, for instance, if the Falco furcatus is to be separated from its kindred, and marked off into a genus by itself, because it has a swallow tail, why are the purple martins, the white-bellied swallow, and the barn swallow, with their forked tails, put in the same genus as the cliff swallow, with its tail perfectly square? If the night-hawk is to be separated from the goat sucker because it has no bristles at the base of its mandible, why is not the Hirundo serripennis made into a distinct genus because it has spines where no others of the genus Hirundo are known to have them? In short, we think the quinary system a very objectionable one, tending to perplex and mystify the science of ornithology, with no substantial foundation—indeed with none at all, beyond the accidental whims and caprice of its founders. We regret therefore the necessity under which Mr. Audubon felt himself to lend to it the weight of his authority, by adopting it. We mean to convey no censure whatever upon him for having done so. For while we know full well there is no one more fully sensible of its imperfections than he, we know too that it was only because he would be exposed to the hasty and unjust censure of foreign critics if he did not do so, that he submitted to the necessity of the case. We all know the sneering manner in which his first work was spoken of by an English naturalist, very far Mr. Audubon's inferior in every respect, solely because he had not seen fit to adopt this system then. We were gravely informed that our birds had been "so admirably figured by the celebrated Wilson that little has been left for those who have gone over the same ground."* Again we were told "Mr. Audubon's two volumes may be consulted with advantage, but the scientific descriptions are destitute of that precision and detail which might have been expected in these days; and *as the nomenclature is not that now in use*, it is impossible to make out the *modern* genera," &c.

The verdict of the intelligent public have however seen fit to set aside, in one instance, a decision so wholly unjust, and we believe it would have done so again. Still we think Mr. Audubon right in consulting his interest rather than incur the risk of having his new work shut out of the pale of foreign favor. We could not however forbear entering our humble protest against this cumbersome, unwieldy, top-heavy system, which, we trust, will soon crumble into fragments, from its own want of symmetry and ill-arranged proportions, and from its ruins arise a new one, upon which Dame Nature may not dread to look for fear of being frightened at her own distorted image.

The volume before us, if it shall be succeeded by others of equal merit, affords a promise which we have no doubt will be fulfilled, of the best work on American ornithology yet published. To the student the plates it contains offer all the advantages that are to be derived from the larger work, while the text, having been arranged and well assorted, is free from the confusion and contradictions arising from new discoveries, and other necessary faults in a work published, as was his first, in the midst of his labors, and while the results of his investigations were constantly rendering what he had before written, nugatory and out of date. In short, we have here presented to us at a single view, the discoveries and labors of a lifetime.

A large portion of the text of this volume is the same with what has already appeared in his former work. There is however much that now appears for the first time, and which is replete with interest and information. We regret that our narrow limits forbid us to make extracts. We can therefore only glance at a few instances.

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* Swainson on the Natural History and Classification of Birds, Lardner, V, p. 83.

His remarks relative to the flight of diurnal birds, more especially of the falcons, given in the history of Harris' Buzzard, p. 25, present many new and interesting facts and observations. Mr. Audubon's experience has led him to the conclusion that a greater length of wing affords no indication of consequently greater power of flight in any species. The power of flight is dependent upon the rapidity with which the wings are moved, and the muscular energy applied to them. In evidence of this he cites the turkey buzzard, which, notwithstanding its very ample wings, is one of the very slowest birds. The golden eagle, which has universally been considered a bird of most extraordinary powers of flight, is little better than a sluggard. The various groups of hawks are classified by their mode of flight, but we have not room to state the classification at length. The swiftest group is that containing the pigeon hawk, goshawk, etc. The speed of the latter is so great as to enable it to outstrip even the wild pigeon, the swiftness of whose flight is proverbial.

Some diversity has existed among our ornithologists of late years relative to the plumage of the little screech owl; the disagreement being which is the old bird, that with the red or that with the gray plumage. This controversy, supposed to have been settled by the fact that Mr. Samuel Cabot, Jr. shot a red plumaged female in the act of feeding gray plumaged young, is, it seems, still mooted. Mr. Audubon says: "the *Red Owl* of Wilson and other naturalists is merely the young of the bird called by the same authors the *Mottled Owl*, and which in fact is the adult of the species." While we confess our own leaning to be slightly in favor of the seniority of the red plumage, we cannot decide between such conflicting opinions without clearer evidence than has been adduced. The question is an interesting one, and we hope some one having the means will keep live specimens of birds in each plumage, for the purpose of definitely ascertaining the adult.

Among those species the existence of which on this Continent was a matter of doubt, or even wholly unsuspected, there are several given in this volume, which have now ceased to be subject for longer uncertainty. These are as follows: the Caracura eagle, found in Florida; Harris' buzzard, new species, shot in Louisiana; common buzzard, Columbia river; little night owl, European species, obtained near Pictou, in Nova Scotia, where it was said to be not uncommon; little Columbian owl, Columbia river; Tengmalm's owl, near Bangor; violet-green swallow, Rocky Mountains; rough winged swallow, Louisiana; Rocky Mountain fly-catcher, North California; and Townsend's Ptilogonys, Columbia river. The proportion will be seen to be very large, being no less than ten out of seventy species described.

But we have already extended our article too far, and must take leave, at least for the present, of a subject so replete with interest. We have only to add, that if the residue of the publication shall equal the numbers now issued, with especial pains taken to secure the accuracy of the coloring of the several plates, the present work will without exception be the most splendid one on natural history that has yet been published in the country.

Art. XI.—*On a supposed new Mineral Species;* by Charles Upham Shepard, M. D., Prof. of Chemistry in the Medical College of South Carolina.

The mineral here described, is one with which mineralogists have, to a certain extent, been acquainted for several years. From a list of localities, by Dr. Joseph Barratt, prepared in 1824, and published in the 9th volume of this Journal, (pp. 39—42,) it appears to have been first discovered in 1820, at Phillipstown, Putnam county, New York; and was from that time until very recently, regarded, in common with the other varieties of the same substance hereafter to be mentioned, as Sphene. A second locality of the mineral was made known by Dr. A. F. Holmes, of Montreal about eight years ago, who obtained it in considerable abundance from Grenville, in Canada.

My attention was first directed to a peculiarity in the cleavages of the Grenville specimens, in the year 1834. I observed they afforded an oblique rhombic prism, whose lateral faces inclined to each other, according to measurements with the common goniometer, under angles of about 123° 30′. The fact appeared to me of sufficient interest to be mentioned in my Treatise on Mineralogy, and I accordingly introduced it in the form of a note, under Sphene, (Vol. II, part 2nd, p. 201.)

In a letter from H. J. Brooke, Esq., dated London, May, 1837, (accompanied by a box of minerals,) my attention was directed anew to the subject, by receiving from him a specimen of the Phillipstown mineral, along with the following remarks. "I send a specimen of a mineral found in Canada, and near West Point. It was ticketed Sphene, but its measure on the only faces I have found, differs from Sphene, and every other mineral I am acquainted with. It splits parallel to the planes of a rhombic prism of about 125° 15′. I conclude that it is an undescribed substance. Can you find it in crystals?"

In reply to which, I referred Mr. Brooke to the note in my Treatise above alluded to, and transmitted him specimens from Canada, upon which in a letter of 1838, he remarks again as follows: "Dr. Forchammer, of Copenhagen, took specimens of the Canada Sphene with him last year to analyze, and I expect his results shortly. I have the angle of the Canada variety 125° 30′, instead of 123° 30′."

Nothing farther, to elucidate the subject, had transpired last October, when I had an opportunity of examining, with Mr. Brooke, in his own cabinet, the specimens he possessed from the localities above mentioned.

On a visit to the mineral district of St. Lawrence county, (N. Y.,) in company with Baron Lederer, of New York, and Capt. Williams, of Bristol, Conn., I had the pleasure of obtaining from two recently discovered localities, highly perfect crystals of the mineral under consideration. One of these was on Mr. Cleveland's farm, near a place called Natural Bridge, in Lewis county, where it occurs in small quantity, in coarse granular limestone, associated with a dark colored pyroxene, a pearl-blue scapolite, (nuttallite,) and crystallized white feldspar. The other locality is in a similar formation, at a spot called Robinson's mine, two miles from the Rossie lead mine in St. Lawrence county. At this place the associated minerals are, (besides pyroxene, scapolite, and feldspar,) apatite in large green crystals, zircon, and plumbago.

The crystals vary much in size, from above an inch to one eighth of an inch in diameter, and are variously blended up with, and implanted upon, some one or all of the above mentioned species.

The primary form of the crystals is an oblique rhombic prism, whose bases are oblique, from an obtuse edge; the inclinations being M on M=112° 10′ and M on P=115° 30′. Several crystals of this form were observed at Natural Bridge.

Figures 1 and 2, however, represent the usual forms of the mineral; and it is a somewhat remarkable circumstance, that it appears to be as rare at these localities, under a compound or massive form, as it is under regular crystals at Phillipstown and Grenville.

Fig. 1.

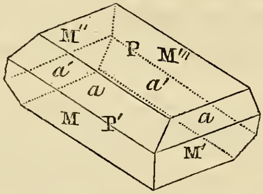
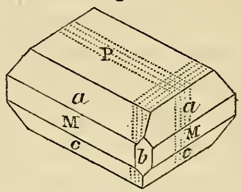


Fig. 2.



P on *a*	. . . .	141° 30′ to 142°
M " *a*	. . . .	151 30
a " *a*	. . . .	137 30
M " *c*	. . . .	135 10
c " P′	. . . .	110 30
M " *b*	. . . .	145 00
P " *b*	. . . .	118 00?

The edges of the crystals are generally sharp and well defined. The faces also are flat, though considerably pitted, from a natural incompleteness in part, but still more from imbedded minerals, as apatite, zircon, pyroxene, plumbago, &c. It must not be considered, therefore, that the angles above given, will be found incapable of correction. They are, however, the averages of numerous trials, the limits of variation were generally within 40′.

No very marked difference in lustre is perceptible on the dissimilar faces of the crystals, if we except *c* and *b*, which are both inferior to the others in this respect.

The planes P, on a few of the crystals, exhibit delicate lines of cleavage in two directions, approaching, but not identical with, their edges of intersection with M and M; which cleavage marks are likewise visible on the lateral planes, both primary and secondary, as denoted in figure 2. The cleavage which takes place in conformity with these lines, does not afford a solid of the same dimensions with the primary form. Indeed, there is a constant difference between the two cleavages, as to the facility with which they are effected, and the lustre of the resulting faces. The inclination of the most brilliant cleavage plane to P, is between 130° and 131°, while the cleavage prism itself affords an angle of 125° 30′, and exhibits qualities which prove it identical with those cleavage forms so readily obtained of the mineral from Phillipstown and Grenville. No cleavage appears in other directions;* but the mineral on being broken shows an uneven or sub-conchoidal fracture.

Lustre vitreous, inclining to adamantine. Color dark clove-brown, (St. Lawrence county:) chocolate-brown, (Phillipstown:) light clove-brown, (Grenville.) Semi-transparent to translucent.

Hardness=5.5 ... 5.75.

Sp. gr.=3.33 ... 3.34, *(St. Lawrence county;)*=3.43 ... 3.48, *(Phillipstown;)*=3.45 ... 3.57, *(Grenville.)* The slight discrepancies in specific gravity among the specimens from different localities, probably arise from the adherence of foreign minerals.

When heated before the blowpipe it affords the same phenomena as Sphene.

From the foregoing description it will be obvious, that the only difference between the mineral under consideration and Sphene, (independently of chemical composition, of which, as yet, we know nothing,) is confined to crystalline form. The attention of crystallographers is now invited to the subject. Should it be admitted, as it appears to me probable, that to reconcile them will be impracticable, we shall then have (apart from the possible discovery on analysis, of dimorphism,) a new species in the varieties here described; in that event, I shall bespeak for them the name of *Lederite*, an appellation in which every American cultivator of mineralogy will, I am confident, be happy to acquiesce.

New Haven, Aug. 31, 1840.

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* With the exception of what is observable in a single specimen, where a perfectly foliated structure is visible in the direction of a tangential truncation of one of the edges between *a* and P. The lustre of this cleavage plane is highly splendent.

MISCELLANIES.

DOMESTIC AND FOREIGN.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

1. *Proceedings of the American Philosophical Society, Philadelphia.** *October* 18, 1839.—Mr. S. C. Walker, in behalf of the Committee on the paper entitled, "Astronomical Observations made at Hudson Observatory, &c., by Elias Loomis, Professor of Nat. Philos., &c. in the Western Reserve College, Hudson, Ohio," made the following report:—

The memoir of Prof. Loomis contains a description of the Hudson Observatory, erected at the expense of the Western Reserve College at Hudson, Ohio. The building consists of a central portion, fifteen feet square upon the inside. From a circular platform of ten feet diameter, rise twelve small cherry columns, that sustain a hemispheric dome of nine feet internal diameter, covering a five and a half feet equatorial of 3.8 inches aperture, by Simms. The dome rotates on ten lignumvitæ wheels of five inches diameter. The equatorial rests on an insulated pier, descending six feet below the surface of the ground, and rising three feet above the platform, which is itself about six feet above the surface of the ground.

The eastern wing is ten feet by twelve, and seven and a half feet high, and covers a Simms' transit circle of eighteen inches diameter, graduated on platinum to 5′, and reading to single seconds by three Troughton's microscopes. The telescope has a focal length of thirty inches and an aperture of 2.7 inches. The transit circle, and a clock by Molyneux, are each mounted on separate insulated piers. The western wing contains no instruments; but serves for a lodging-room, computing-room, &c.

Professor Loomis gives the following results for the latitude of the Hudson Observatory.

			°	′	″
By u. c. Polaris,	Aug. 8,	Latitude	41	14	39.8
	" 10,				36.7
	" 13,				36.8
	" 14,				37.8
	" 15,				40.8
	" 17,				36.6
		mean,	41	14	38.1

* So much has accumulated since our last publication of the Proceedings of the American Philosophical Society, that we are under the necessity of abridging to some extent the abstract given by the Society.—Eds.

		°	′	″
By u. c. δ ursæ minoris, Aug. 13,	Latitude	41	14	35.1
" 17,				36.2
	mean,	41	14	35.7

From which he concludes that the latitude is 41° 14′ 37″ nearly.

The paper contains a series of fifty moon culminations, one eclipse, and six occultations, observed in 1838 and 1839. These furnish data for determining the longitude of the Hudson Observatory when corresponding European and American observations shall have been obtained. Prof. Loomis gives for the approximate longitude 5*h*. 25*m*. 42*s*. It may be proper to add, that one of the undersigned, S. C. Walker, having reduced the six occultations contained in this paper, and compared them with four corresponding observations at the Philadelphia Observatory, four at the Dorchester Observatory, two at Mr. Paine's House, Boston, and one at Princeton College, New Jersey, finds for the longitude of the Hudson Observatory 5*h*. 25*m*. 47*s*.

The instruments for this observatory were selected by Professor Loomis during his late journey in Europe. This economical establishment appears to be more complete than any of the kind now known to be in operation in the United States, and the Committee cordially recommend the example of the Western Reserve College, as worthy of being followed by those universities which are desirous at moderate expense, of inculcating practical astronomy, of making observations highly useful for geographical purposes, and of prosecuting interesting researches connected with the progress and advancement of astronomy.

The Committee recommend the paper for publication.

Sears C. Walker,
R. M. Patterson, } *Committee.*
Geo. M. Justice,

The recommendation in favor of publication, was adopted.

Dr. Bache, on behalf of the Committee on Dr. Hare's paper entitled "On the extrication of Barium, Strontium and Calcium," reported in favor of publication in the Society's Transactions, which was ordered accordingly.

In this paper Dr. Hare first calls attention to the following phenomenon observed by him almost twelve years since, and published. When the circuit in a galvanic battery, the deflagrator of the author, was completed through a saturated solution of chloride of calcium, the anode being formed by a coarse, and the cathode by a fine platinum wire, the latter was rapidly fused, while, when the situation of the wires was reversed, the ignition was comparatively feeble. It having occurred, some months since, to Dr. Hare, that this phenomenon might be due to the evolution and combustion of calcium at the cathode, he proceeded to apply a galvanic deflagrator of three hundred and fifty pairs of plates, in the process of Berzelius and Pontin, for preparing the amalgams of the metallic radicals of the earths. The author gives a sketch of the present state of our knowledge in relation to the metallic bases of the alkaline earths, as derived from the experiments of Davy; adding his own observations, in confirmation of the declaration of Davy, that the substances obtained by him from baryta and strontia, were amalgams of their metallic bases, and not the bases themselves; and, further, that the process employed for obtaining calcium, by Davy, was really incompetent to effect the desired result. He then proceeds to describe the peculiar apparatus by which amalgams of barium, strontium and calcium were procured; the chlorides of the respective alkaline radicals being exposed to galvanic action, the cathode being mercury, and the anode a coil of platinum wire. The details of the apparatus cannot be properly understood without the figure which accompanies Dr. Hare's communication: its chief peculiarities are the following: 1st. It furnishes the means of keeping the mercury, forming the cathode, at a temperature nearly as low as 32° Fah. 2d. It prevents exposure of the amalgam of the radical, to the direct action of the chlorine from the chloride used. 3d. The alternate and successive, or the simultaneous action of two galvanic deflagrators, was conveniently obtained.

Dr. Hare states, that after operating with a series of two hundred pairs of plates of one hundred square inches each, for twenty minutes, unaided by these improvements, he had found the proportion of calcium to be but one six-hundredth part of the amalgamated mass.

An apparatus for distilling the amalgam is also described and figured in Dr. Hare's memoir. It consists of an iron alembic, connected with a glass receiver, and an adopter communicating with a reservoir of hydrogen, and containing chloride of calcium and quick-lime. Within the alembic, an iron crucible, containing the amalgam, was placed, the crucible being closed by a capsule, in which was a portion of caoutchoucine, and by its cover. Naphtha was poured into the alembic. The air from the apparatus was expelled by hydrogen, desiccated by passing through the chloride of calcium and quick-lime in the adopter. The distillation was conducted by applying heat principally to the upper part of the amalgam, to prevent an explosive ebullition. The mercury being distilled off, which requires a bright red heat in expelling the last portions, the metallic radical remained in the crucible.

The metals oxidize rapidly in water ; are brittle, fixed, and require a good red heat for fusion. They sink in sulphuric acid. By keeping in naphtha, they acquire a coating which renders them less active when exposed to water.

Dr. Hare attempted to separate the mercury from the amalgams when solidified by the use of solid carbonic acid, by straining them through leather, but the result did not answer his expectations.

By using solid carbonic acid and hydric (sulphuric) ether, Dr. Hare solidified a mass of the amalgam of ammonium. He considers that in this case a portion of ether combines with the alloy, without impairing its metallic character.

Professor Bache, in behalf of Professor Alexander, of Princeton, made a verbal communication of a description of the aurora borealis, of September 3d, 1839, as it appeared at Princeton.

At about ten or fifteen minutes past eight, P. M. an ill-defined, but considerably bright light was seen to extend for some distance above the horizon, in a direction nearly due east ; it was similar, in intensity and appearance, to a lunar twilight. Soon after this, a continuous arch or zone of light was manifest, extending from the same spot to the opposite, or nearly opposite portion of the western horizon. This soon separated into two parts,* and, after a short interval, beams of light shot up from the eastern portion of the arch, which were speedily multiplied in every direction around the observer, except within about thirty degrees of the *true* (or it might be *magnetic*) south.

A corona was soon formed, which was at first quite indistinct, and was not continuous for any great length of time, during the existence of the aurora, except at the period of its greatest brilliancy. At about twenty minutes past eight, this corona was situated in a line with, and about midway between α Aquilæ and α Lyræ. This may be considered as a very tolerable approximation to its position, though, from the apparent intersection, or, as it might almost be termed interweaving of the beams which composed it, it was not often easy to fix upon the place of its centre with much precision, if indeed that which seemed its centre, did not really change its place ; since, at times, it seemed to occupy a position very sensibly lower than that which the preceding observation would indicate.

At about half past eight, the appearance of the aurora was superb. The radiations which extended from the corona, nearly reached the horizon in every direction, with the exception of those which tended toward the southern space before-mentioned, which, it is believed, was

* Two arches, it is believed, were at this time formed, and either separated throughout their entire extent, or united only near their extremities ; but this my notes do not explicitly state.

even at this time bounded by something like an arch, that was convex toward the zenith. The aurora was often party-colored; frequently of a rose-red, especially in spots, in that portion of the sky which might be supposed to be near the plane of the dipping needle; and also about the center of the corona. It was in the part of the heavens here described, that the arch of greatest intensity could most commonly, if not uniformly, be traced: though the crown of it frequently faded away, or became excessively faint.

Between the spots of red light, or beams of the same tint, others were observed, which, either from the effect of the first mentioned color, or something peculiar to themselves, appeared of a color approaching to a bottle-green.

At times, again, when the corona was deficient, the appearance of what remained on each side of the vacant spot, was not unlike that of two immense comets; their heads some small distance asunder, and their tails turned eastward and westward.

The light of the corona, when most perfect, was quite dense, not only at the central point, but also near to what seemed to be the outer limits of its radiations, at which the tint commonly exhibited the nearest approach to white.

Two meteors or shooting stars were seen, which in both cases *appeared* to pass *between* the aurora and the eye of the observer; one nearly in the direction of the arch of greatest intensity, and the other almost perpendicular to it. The precise times of their appearance were not noted, though they fell within that period in which the phenomena already described were exhibited.

The corona formed again at nine; and, though again broken, was imperfectly visible after that time.

At half past nine, the eastern portion of the sky became tinted with intense red and green; but at half past ten, little else remained than the appearance of bright horizontal beams of a white color in the north.

If it be admitted that the centre of the aurora was precisely midway between α Aquilæ and α Lyræ, at twenty minutes past eight, its azimuth must have been $1° 14' 42''$ E. of S., and its altitude $73° 27' 6''$; the latitude of the observer being $40° 20' 47''$ N. The point thus designated, would be very nearly in the direction of the dipping needle; the dip being, by observation, $72° 47' 6''$ ($72° 47.1'$) and the variation (though not accurately determined,) some $4°$ W. or that of the S. end of the needle, of course, the same extent to the east. The degrees of azimuth, reckoned on a parallel to the horizon at an altitude of $72°$ and more, being small, the deviation from the direction of the dipping needle, measured on the arc of a great circle, would be scarcely more than $1°$ towards the N. W.

Professor Bache stated that his own observations near Philadelphia, of the altitude of the apparent converging point of the auroral beams, at nine, P. M. made it but about 69°. He had witnessed a case of the appearance of a dark spot of irregular shape, between two beams of light, which was certainly not a cloud, as the stars were not at all obscured by it, and which he supposed to be the phenomenon referred to recently by Professor Lloyd. No mottled clouds, such as usually attend the aurora, were visible during the period between nine and ten o'clock, when he had been able to observe. Professor Bache stated that he did not place much stress upon his measurements, as he had been prevented from sustained observation by indisposition. There had been, in the newspapers, an account of an auroral display visible at London, on the morning of the fourth of September, at about the same absolute time as at Princeton, according to Professor Alexander's observations. It was said to have been accompanied by a very unusual number of shooting stars, compared in one statement to the splendid display of November 13th, 1833.

Professor Henry had examined the light of this aurora by the polariscopes of Savart and Arago, but had not been able to detect the slightest trace of polarization.*

The following gentlemen were duly elected members of the Society:—

Thomas U. Walter, of Philadelphia.
John Penington, of Philadelphia.
Eugene A. Vail, of Paris.
Charles Rumker, of Hamburgh.
Charles Gutzlaff, of Macao.
John Washington, Captain R. B. N.
Elias Loomis, of the Western Reserve College, Ohio.
Stephen Alexander, of Princeton College, N. J.

November 1, 1839.—The Committee, consisting of Dr. Bache, Dr. Patterson and Mr. Booth, to whom the paper of Dr. Hare, read at the last meeting of the society, was referred, entitled, "Description of an Apparatus for deflagrating carburets, phosphurets, or cyanides, in vacuo, or in an atmosphere of hydrogen, between electrodes of charcoal; with an account of the results obtained by these and other means, especially the isolation of calcium, and formation of a new fulminating compound. By R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania," reported in favor of publication in the Society's Transactions. The publication was ordered accordingly.

* Other observations, made in this country and in England, on this magnificent Aurora, have already appeared in this Journal, (Vol. xxxviii, pp. 146, 260, and 376.)—Eds.

The apparatus is of a convenient construction for the purposes designated in the title of the paper. The lower electrode or cathode is a parallelopipedon of charoal, on which the body is placed, to be subjected to the influence of one or more batteries ; and tubes, with valve-cocks, communicating with an air-pump, a barometer-gauge, and a reservoir of hydrogen, open into the interior of a ground plate, on which a bell-glass is fitted, air tight. In the experiments of the author, an equivalent of lime was heated with one equivalent and a half of bicyanide of mercury, in a porcelain crucible, enclosed in the alembic made for this purpose, and described in a former paper. (See p. 131 of the Proceedings.) The weight of the residue was such as would result from the union of an equivalent of calcium with an equivalent of cyanogen. This was then subjected to galvanic action on the cathode of the apparatus, the anode being brought in contact with it, and the result was the production of masses on the charcoal, having a metallic appearance.

Phosphuret of calcium, exposed in the same manner, in the galvanic circuit, left pulverulent matter which effervesced in water, and, when rubbed on porcelain, appeared to contain metallic spangles, which were rapidly oxidized in the air.

In one experiment, particles of charcoal, apparently fused or resembling plumbago, dropped from the anode.

After heating lime with bicyanide of mercury, the mass was dissolved in acetic acid, in which nitrate of mercury produced a copious white precipitate, that detonated under the hammer like fulminating silver.

November 15.—The committee, consisting of Dr. Patterson, Mr. Justice, and Prof. A. D. Bache, on Mr. E. Otis Kendall's paper, read November 1, and entitled "On the longitude of several places in the United States, as deduced from the observations of the Solar Eclipse of September 18th, 1838. By E. Otis Kendall, Professor of Mathematics in the Central High School of Philadelphia," reported in favor of publication in the Society's Transactions. The publication was ordered accordingly. The following abstract of the paper was contained in the report of the committee.

The paper contains the reductions of all the observations of the Annular Eclipse of the Sun, September 18th, 1838, yet reported to the Society; together with those of Mr. Hallowell at Alexandria, D. C.; of Messrs. Olmsted, Mason and Smith, at New Haven, Conn.; and of Mr. J. Blickensderfer, jr. of Dover, Tuscarawas county, Ohio. The computations were made after Bessel's method.

The corrections of the elements in the Nautical Almanac as derived from eight equations of condition, from the durations of the ring, and twelve from that of the eclipse, were—

$\varepsilon = -14.''782 =$ correction of moon's place on true orbit.
$\zeta = -\ 7.''310 =$ correction of do. on a secondary to do.
$\eta = -\ 3.''198 =$ correction of sum of semi-diameters.
$\eta' = +\ 0.''515 =$ correction of difference of do.

In which η and η' refer to Burckhardt's semidiameter of the moon and Bessel's semidiameter of the sun. The value of ε is obtained by assuming the longitude of the State House, Philadelphia, to be 5h. 0m. 39s. west of Greenwich. After applying these corrections of the elements, Mr. Kendall deduces the following longitudes of the places of observation.

Place of Observation.		Long.+East,—West from Greenwich. h.	m.	s.
Western Reserve College, Hudson, Ohio,	B.	—5	25	40.70
Dover, Tuscarawas County, Ohio,	B.	—5	25	52.71
	F. R.			45.44
	R. R.			59.60
	E.			59.45
Alexandria, D. C. . . .	B.	—5	8	24.44
	F. R.			29.16
	R. R.			16.46
	E.			38.79
Washington Capitol, . . .	B.	—5	8	3.25
	F. R.			2.72
	R. R.			2.73
	E.			1.96
Haverford School, Penn. . .	B.	—5	1	12.03
	F. R.			13.98
	R. R.			13.71
	E.			17.73
Philadelphia State House, . .	B.	—5	0	37.79
	F. R.			38.72
	R. R.			40.16
	E.			39.32
Germantown, Penn. . . .	B.	—5	0	40.99
	F. R.			40.75
	R. R.			38.83
	E.			36.06
Burlington, N. J. . . .	B.	—4	59	24.69
	F. R.			28.99
	R. R.			29.55
	E.			30.35
Princeton, N. J.	B.	—4	58	43.69
	F. R.			43.68
	E.			30.70
Weasel Mountain, N. J. . .	B.	—4	56	46.75
	F. R.			48.26
	R. R.			49.10
	E.			51.34

Place of Observation.		Long. + East, — West from Greenwich. h.	m.	s.
Brooklyn, N. Y.	F. B.	—4	56	0.02
	F. R.			0.80
	F. E.			2.31
New Haven, Conn.	B.	—4	51	47.65
	E.			56.82
Southwick, Mass.	B.	—4	51	16.92
	E.			20.16
Wesleyan University, Conn.	B.	—4	50	43.62
	E.			41.73
Williamstown College, Mass.	B.	—4	52	26.93
Dorchester Observatory, Mass.	B.	—4	44	22.76

The committee to whom was referred the paper of Prof. Loomis, entitled "Additional Observations of the Magnetic Dip in the United States," reported in favor of its publication, and which was ordered accordingly. These observations are incorporated in Art. V. of this Vol., p. 41.

The committee, consisting of Dr. Hare, Dr. Bache, and Mr. Booth, on a paper entitled "On a new compound of deutochloride of platinum, nitric oxide, and hydrochloric acid; by Henry D. Rogers, Professor of Geology in the University of Pennsylvania, and Martin H. Boyè, Graduate of the University of Copenhagen," reported in favor of publication in the Transactions of the Society. The publication was ordered accordingly.

This substance is procured by dissolving platinum in an excess of nitromuriatic acid, and evaporating nearly to dryness; after which it is treated with aqua regia, freshly prepared, from concentrated hydrochloric and nitric acids. A little water is afterwards added, drop by drop, just sufficient to keep the chloride of platinum dissolved, when the compound will remain in the form of a gamboge yellow powder. It is then separated by decanting and filtering, and pressed between the folds of bibulous paper, and dried *in vacuo* over sulphuric acid.

The precipitate is a yellow, minutely crystalline powder, which absorbs water with great avidity. It may be preserved, without decomposition, in dry air, or *in vacuo*. It is decomposed by water, alcohol, &c., with extrication of nitric oxide, chloride of platinum remaining in solution. A concentrated solution of chloride of platinum has, however, no action on it. Heated in an atmosphere of hydrogen, it gives off a large amount of chloride of ammonium, leaving a residuum of metallic platinum.

Analysis.—The salt analyzed, was prepared and kept in the manner described. Heated to the temperature of 212° F., it does not part with any of its water of combination. For estimating the amount of platinum and chlorine, the salt was fused with carbonate of potassa, &c., and the platinum, thus obtained, weighed by itself, and the chlorine precipitated from the solution by nitrate of silver.

The quantity of nitric oxide was determined by introducing a portion of the salt into a graduated tube, inverted over mercury, and decomposing it by letting up the requisite proportion of water.

The mean of a series of experiments, varied in different ways, gave

Platinum, - -	41.26 per cent.
Chlorine, - - -	43.89 "
Nitric oxide, -	4.98 "

The above results correspond to five atoms of bichloride of platinum; five atoms of hydrochloric acid, and two atoms of nitric oxide. The water was calculated from the loss, in the analysis, to be equivalent to ten atoms.

Respecting the chemical nature of this compound, it may be regarded, either as a chloride of platinum, with a muriate of nitric oxide, represented by the following formula, $(Pt\ Cl^2)^5 + [(Cl\ H)^5 + (NO^2)^2] + 10\ Aq$, or as a double chlorosalt, a chloroplatinate of nitrogen, with a chloroplatinate of hydrogen, represented by the formula, $[(Pt\ Cl^2)^2 + N\ Cl^2]^2 + (Pt\ Cl^2 + H\ Cl) + 14\ Aq$.

Professor A. D. Bache made a verbal communication in which he compared the observations on the magnetic dip by Professor Loomis, contained in his paper ordered this evening for publication, with those given in a paper by Professor Courtenay and himself, read before the Society in 1834.

The following resolutions in relation to combined magnetic observations were adopted:

Resolved, That in the opinion of the American Philosophical Society, it is highly desirable that the combined series of magnetic observations now in progress under the direction of the British government, should be extended to the United States, by the establishment of Magnetic Observatories at suitable places.

Resolved, That a Committee be appointed, with authority, on behalf of the Society, to invite the attention of one of the departments of the Government of the United States to the plan for combined magnetic observations, a sketch of which was presented in the documents from a Committee of the Royal Society of London, and to urge co-operation in the plan as a national undertaking, in every way worthy of the United States.*

* A Committee were appointed, and a letter or memorial on the subject drawn up by them was addressed to Hon. J. R. Poinsett, Secretary of War. This letter is given at length in the Proceedings, but as it failed to effect its object at the pro-

December 20, 1839.—Doctor Hare made a verbal communication relative to the application of radiant heat to glass.

The combustion of anthracite coal, in an open grate, in his laboratory, having four flues of about 4.12 by 2.12 inches each, in area, just above the level of the grate, (the upper stratum of the fire having nothing between it and the ceiling,) had allowed him to perform some operations with success, which formerly he would have considered impracticable. The fire having attained to that state of incandescence to which it easily arrives when well managed, he had, on opening a hole by means of an iron rod, so as to have a perpendicular perforation extending to the bottom of the fire, repeatedly fused the beaks of retorts of any capacity, not being more than three gallons, causing them to draw out, by the force of gravity, into a tapering tube; so that, on lifting the beak from the fire, and holding the body of the retort upright, the fused portion would hang down so as to form an angle with the rest of the beak, or to have any desired obliquity. By these means, in a series of retorts, the beak of the first might be made to descend through the tubulure of a second; the beak of the second through that of a third, and so on; the beak of the last retort in the row being made, when requisite, to enter a tube passing through ice and water in an inverted bell-glass.

Dr, Hare further communicated a method of preparing pure chlorohydric acid, from the impure muriatic acid of commerce, by the action of sulphuric acid.

It is known, said Dr. Hare, that concentrated sulphuric acid, when added to liquid chlorohydric acid, expels more or less of it as a gas, in consequence of its superior affinity for water. At the present low price of the ordinary acid of commerce, Dr. Hare had found it advantageous to procure the latter in purity, by subjecting it to the former.

A tubulated glass retort, having been half filled with chlorohydric acid, sulphuric acid was allowed to drop from a glass funnel, with a cock, into a tube descending into the acid in the retort, through the tubulure, to which it was luted by strips of gum-elastic. The tube terminated in a very small bore. The beak of the retort, bent in the fire, as he had just described, descended through the tubulure into the body of a small retort containing water not refrigerated. The beak of the latter descended into a larger one, half full of water, to which ice was applied. Of course the beak of the third might, in like manner, enter the body of a fourth. After an equivalent weight of sul-

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per time, we do not insert it, although it is a most able document, and should be generally read. This letter, owing to the representations of the Secretary of War, was referred to a select committee of Congress.—Eds.

phuric acid had been introduced, and the evolution of gas was no longer sufficiently active, heat might be applied until nearly all the chlorohydric acid should come over.

The residual diluted sulphuric acid was, with the addition of nitrate of soda or potassa, or nitric acid, as serviceable for galvanic purposes, as if it had not been thus used.

Dr. Hare further communicated a method of preparing hydrochloric acid and chlorine in the self-regulating reservoir invented by him, and spoke of some of the applications of the gases thus prepared.

By means of the reservoir of chlorohydric acid he had been encouraged to make an effort which proved successful; to form artificial camphor by the impregnation of oil of turpentine with that gas.

Subjecting an ingot of tin to a current from his reservoir of chlorine, it was rapidly converted into the bichloride, or fuming liquor of Libavius. To his surprise the ingot was fused by the heat generated. In the last mentioned reservoir the materials were manganese, in lumps, and concentrated chlorohydric acid, diluted sulphuric acid being also introduced; as the reaction of this last mentioned acid with the manganese was more active than that of the chlorohydric acid. In fact, sulphuric acid, diluted with its weight of water and common salt, might be used without chlorohydric acid. In the reservoir for chlorohydric acid, the materials were sal ammoniac and sulphuric acid, to which some water was added, but not so much as to prevent the chlorohydric acid from assuming the gaseous state.

Mr. Sears C. Walker made an oral communication on the subject of determining longitudes from corresponding observations of meteors.

It had been recently remarked by Prof. Schumacher, Astr. Nachr. No. 283, that, so far as his information extended, no trial had been made of the observation of meteors for determining longitude; though the subject had been proposed long since by Prof. Benzenberg. Accordingly, on the 11th of August, 1839, observations, chiefly of the instant of vanishing of meteors, were made at the observatories of Altona, Bremen, Königsberg, Breslaw, &c., with such success as to lead Dr. Olbers to the conclusion announced in a succeeding No. (284) that observations of this kind are adequate for the complete determination of longitudes of places. By means of twelve coincidences on the same night, Prof. Boguslawski found the Breslaw Observatory to be 28m. 22.07s. east of Altona, differing less than a second from that which had been previously adopted.

As the subject of priority in this inquiry might be considered important, Mr. Walker deemed it his duty to communicate the substance of a letter from Prof. Alexander, of Princeton College, New Jersey, dated January 14th, 1839, in which is contained the result of seven coincidences of observations of meteors, made 25th Nov. 1835, by Messrs. A. D. Bache and J. P. Espy, at the house of Prof. Bache, in Philadelphia, and by Professors Henry and Alexander, at the Philosophical Hall, 0.1*s*. east of Nassau Hall, College of New Jersey, at Princeton. As the time referred to by the Philadelphia observers is that of the University of Pennsylvania, which is about 0.7*s*. west of the State House, Philadelphia, the differences of longitude, given by Prof. Alexander, have been diminished by 0.6*s*. to reduce them to the State House, Philadelphia, and Nassau Hall, Princeton. The results are contained in the table. The time of the disappearance of the meteors was noted.

Meteor.	N. Hall, East of State House.	Comparative Weight.	Observers.
a	+2m. 0.45sec.	1	Espy and Alexander.
b	+2 " 0.30 "	1	" and " and Henry.
c	+1 " 59.20 "	0.5	" and Henry.
d	+2 " 0.20 "	1	" and "
e	+2 " 1.00 "	1	Bache and "
f	+2 " 0.80 "	1	" and Alexander.
g	+2 " 2.60 "	0.5	Espy and Henry.
Mean according to weights	+ 2 *m*. 0.61 *sec*.		
S. House, W. of Greenwich	—5 *h*. 0 " 39.12 "		
N. Hall, W. of Greenwich	—4 " 58 " 38.51 "		

The longitude of Nassau Hall: mean of meteoric, chronometrical, and astronomical determinations; is — 4h. 58m. 38.20s.

2. *Proceedings of the Boston Society of Natural History. Compiled from the Records of the Society, by* Jeffries Wyman, M. D., *Recording Secretary.*

Feb. 26th, 1840.—B. D. Greene, Esq. in the chair.

Dr. A. A. Gould laid before the Society the following descriptions of new species of shells, by Prof. C. B. Adams.

1. Cerithium terebrale. C. testâ parvâ, elongatâ, sæpe albocinctâ; anfractibus duodecim planulatis; cum quatuor elevatis lineis, quorum suprema in altera anfractu, supra inferum in precedente, supra posita est; spirâ elevatâ, conicâ, suturâ subimpressâ; aperturâ ovatâ, parvâ; caudâ ad sinistrum tortâ.

Remarks.—This shell is found in New Bedford and vicinity, in the soft mud below low-water mark. It was first regarded as a variety of the C. Emersonii; it differs from that shell however in having a large elevated ridge in the place of the carina on the upper part of the whorls of the spire. The entire want of granulations distinguishes it from the common type of the species. It is distinguished from the Murex tubercularis, Mont., by the same character.

2. Planorbis virens. P. testâ parvâ, viridi, striis transversis crebris revolventibus tenuissimis; anfractibus quatuor; spirâ haud prominente; vix concavâ; anfractu ultimo superne sub-planulato; inferne sub-carinato; labro superne prominente; umbilico subulato profundo. Habitat New Bedford.

Remarks.—This species differs from P. parvus, Say, in being much less broadly and more deeply umbilicate beneath; it is also higher. P. parvus instead of being subcarinate on the lower side is much flattened. P. concavus, Anthony MSS., resembles this species, but is more convex above and concave beneath.

3. Limnea acuminata. L. testâ fragili, semitransparente, ovatâ, striis transversis irregularibus revolventibus creberrimis parallelis; anfractibus quatuor; spirâ perbrevi, subacutâ; anfractu ultimo maximo; aperturâ amplissimâ, spiræ interiorem ostendente; columellâ tenui subreflexâ; labio haud appresso. Habitat New Bedford.

Remarks.—This differs from the L. columella, Say, in the much greater proportional size of the last whorl, the breadth of the shell and the presence of very distinct revolving lines. It resembles the Succinea obliqua, Say, but the spire is rather less, and no revolving lines are mentioned in the description of that species. The L. acuminata has also been found at Horn pond, in Woburn, Mass., by T. J. Whittemore, Esq.

4. Limnea umbilicata. L. testâ fuscâ, ovatâ, striis transversis revolventibus tenuibus; anfractibus quinque convexis; suturâ perimpressâ; spirâ subacutâ; anfractu ultimo subgloboso; aperturâ ovatâ dimidio longiore quam spirâ; labro intus fusco marginato, punicea albo submarginato; columellâ late reflectâ, obsolete plicatâ; umbilico subamplo haud profundo. Habitat New Bedford.

Remarks.—For this and the second species described above, Prof. Adams is indebted to Mr. Shiverick. The L. umbilicata resembles L. caperatus of Say, but in the latter the aperture is about one half the length; revolving lines are raised, more distinct and numerous; umbilicus is rather less, and there is one more whorl.

5. Limnea pallida. L. testâ ovatâ fusiformi pallidâ; anfractibus quinque; sutura impressa, spirâ conica subacuta; anfractu postremo producto; apertura superne acuta, haud magna; umbilico parvo. Habitat Shoreham, Vt., on shores of Lake Champlain, clinging to rocks and stones.

Remarks.—This species most resembles L. acuta, Lea; it differs from it in being long, striate, and of a pale brown color, like the weathered shells of kindred species. The figure of the L. acuta represents the columella as intruding upon the aperture, which is not the case with this shell.

6. Cyclas elegans. C. testâ bizonatâ, subglobosa, rhombico orbiculari, equilaterali, eleganter et tenuissime striatâ, natibus haud prominentibus; umbônibus tenuibus; infra albo-cœrulescente.

Remarks.—This shell is remarkable for its inflation, which continues far over the disk of the shell, and terminates quite abruptly near the margin. The circumference very nearly resembles that of the C. calyculata, except that it is less curved below; that shell however is flattish and has prominent beaks. C. rhomboidea, Say, approaches this in form, but is much less inflated between the umbo and margin, has very coarse striæ and is destitute of the paler zones, which in this shell appear to be a constant character.

March 11, 1840.—George B. Emerson, Esq., President, in the chair.

Dr. Storer stated that he had received information from Dr. Kirtland, of Ohio, that the descriptions and figures of the following fishes of the western waters, by the latter gentleman, had been completed: viz. Centrarchus hexacanthus; Polyodon folium; Catostomus Duquesnii; C. melanops; C. gracilis; C. anisurus; C. elongatus; Hyodon turgissus; Pimelodus cupressus; P. limosus; P. cœruleus; Catostomus bubalus; C. nigrans; Chatoessus ellipticus; Lepisosteus oxyurus; L. platostomus; L. ferox; Leucioperca Americana; Acipenser nudus; A. macrostomus; Anguilla lutea; Ammocoetes concolor; Labrax chrysops; Icthelis macrochira.

A specimen of shell limestone from Machias, Me. presented for the cabinet by Lynde M. Walter, Esq., was laid on the table. Dr C. T. Jackson stated that this was from the sandstone formation in Machias, Me., and was composed principally of univalve shells. It had been consolidated by the heat of the trap which had forced its way through it, so that in some instances it had been converted into compact and even into crystalline limestone; occasionally the limestone has been broken, by the intermixture of the trap, so as to form limestone breccia.

March 18, 1840.—Thomas A. Greene, Esq. in the chair.

Dr. M. Gay read the following communication from A. A. Hayes, Esq., of Roxbury, on the Native Nitrate of Soda, found in South Peru.

The existence of beds of Nitrate of Soda in Peru has been long known, and the inhabitants of a most arid and desolate region, have made it by simple operations an important article of commerce and manufacture.

This salt has claims of scientific interest quite equal to those of any mineral hitherto discovered. It indicates to us, who are accustomed to a humid climate, with heavy rain storms, a state of atmospheric dryness, as far removed from our experience as the singular products there deposited are from our own rocks and soils.

During the scientific tour of Mr. John H. Blake, of Boston, a great number of specimens, illustrating the forms and composition of this salt, were collected, and I have been able to learn some facts from the chemical examination of them, but have to regret that the loss of Mr. Blake's journal has prevented our having a full account of their geological relations.

The Nitrate of Soda exists in large beds, a few feet below the saline soil, or forming that soil in various places, from Arica on the north and west, to the course of the river Loa on the south. The country is an elevated pampa, having the form of a shallow basin, bounded by the coast cliffs on the west, by the higher pampas on the north, by sandstone hills on the east, and the ravine through which the river Loa falls into the sea on the south. The elevation of the pampa of Tamarugal in the province of Tarapaca is nearly 3300 feet above the level of the Pacific.

The western border or coast presents granite, on which the pale flesh-colored feldspar porphyry, peculiar to volcanic regions, reposes. This rock is doubtless trachyte, and its extent and volcanic character make it one of the most important of known rocks. Imbedded in the soil and forming extensive tracts, are shells of the same species as those now existing in the ocean. A saline soil and other appearances denote that a long line of coast has been elevated from below the ocean's waters. In travelling north, Mr. Blake found that the pampas were broken by ravines, through which the waters from the Cordilleras flow at times. A remarkable feature is disclosed by these ravines: a section always presents a higher level on the north than on the south side, so that each pampa presents a *steppe*, rising as we advance northward. The sandstone hills forming the eastern boundary are of moderate elevation; they contain beds of gypsum, and form the western barrier of another basin, the eastern bounds of which are the Cordilleras.

The pampa is mostly uninhabitable, but spots where water can be obtained, and parts of the ravines are cultivated. Nearly midway between the eastern and western limits of this pampa there exists a buried forest of large trees, mostly of the Algorabo species. The trees are inclined towards the southwest, and the wood is singularly well preserved. Specimens have the color and grain of old mahogany, but are brittle. The gaseous constituents of recent wood seem to have been lost, for although resinous, it burns without flame. From personal examination of the country, east of the sandstone elevations, Mr. Blake concludes that a lake of considerable extent once covered the space between these and the Cordilleras. Numerous volcanic rents now exist among the mountains, and it is probable that the saline matter produced by them was dissolved in the water, forming a lake at the base of the mountains. This lake subsequently broke its barriers, and prostrated a forest then growing where the saline matter is now found. I have carefully examined the earthy matter which is mixed with the nitrate of soda from different parts of the province of Tarapaca, and find that the larger part is composed of fragments of finely powdered shells, the color being unchanged. A brown marl forms the remainder, such as results from the washings of sandstone,—these facts I consider as supporting the conclusion of Mr. Blake. The surface of the pampa is mostly sand, clay, and saline matter. The latter is composed of sulphate of lime and soda, salt, and nitrate of soda—some parts present the nitrate of soda at the surface—at others, a few feet below. These salts have all the physical and chemical characters of salts produced by decomposition and separated by evaporation from solutions. The nitrate of soda is found in distinct strata, a thin layer of brown loam separating the parts; it is also found mixed with salt, and forming a small portion of the whole mass. The refining operations are rude and simple. The richest masses of the native salt are blasted or broken and divided into small portions; with these, copper kettles are in part filled, and water, or the mother water of former operations, is added, and heat applied until a boiling and saturated solution is obtained. The solution is transferred to wooden coolers, where the nitrate of soda crystallizes. The undissolved salt remaining in the kettles is thrown aside, fresh salt being used each time, although not one half of the nitrate of soda is dissolved. The coolers are emptied after the crystals of nitrate have ceased to form; it is dried, packed in bags, and sent to the coast on mules. The wood used in the operations is transported from a distance on the backs of mules from the borders of the pampa. Of late, attention has been turned to using the altered wood of the buried forest, and some excavations promised a supply. Water is found by sinking wells in some places, below the saline soil. The subsistence of the workmen, drivers and mules, is mostly drawn from Valparaiso. The quantity of nitrate of soda which exists in beds is immense, and in addition it is probable that the saline soil would afford a large supply.

Native nitrate of soda, in fractured masses, has a granular structure, arising from the aggregation of irregular rhombic crystals, varying from fine grained to coarse grained. It is brittle, but yields more easily in one direction, separating into angular parts, resembling loaf sugar closely, in some specimens. Color varies from snow-white to reddish brown and gray. Some specimens have a lemon yellow tint irregularly distributed; specific gravity, 2.290; taste, nitrous, with a cooling impression; odor, peculiar, and when warmed resembling chloride of iodine dissolved in water.

Composition of average specimens is nitrate of soda 64.98, sulphate of soda 3.00, chloride of sodium 28.69, iodic salts 0.63, shells and marl 2.60,=99.90.

Mixed with this mineral, I have found nitrate of potash, sulphate of lime, chloride of sodium, iodate of potash or soda, and chloriodate of magnesia, the latter imparting the bright yellow tint which some specimens show.

April 1, 1840.—Dr. D. H. Storer, in the chair.

Dr. Storer presented the following report on the fishes referred to him at the last meeting of the Society.

The fishes presented to the Society at its last meeting, as having been taken from Jamaica pond, about five miles from this city, are the *Osmerus eperlanus*, common smelt. You may be surprised at the circumstance of salt water fishes being taken in a fresh water pond entirely disconnected with the sea. During the preparation of my report upon the Fishes of Massachusetts, I learned from Benjamin Weld, Esq. of Roxbury, it was generally understood that the smelts found in Jamaica pond, were originally placed there by Governor Barnard. Investigating this subject, to procure some certain data, I met with the following extract, in a note, by Daines Barrington, the then Vice President of the Royal Society, to a letter from John Reinhold Foster, "on the management of Carp in Polish Prussia:" "I have been informed by Sir Francis Barnard (the late Governor of New England) that in a large pool which he rented not far from Boston, and which had not the least communication with the sea, several of these fish, originally introduced from the salt water, had lived many years, and were, to all appearance, very healthy."* As I have never heard of this fish having been taken in any other pond in this neighborhood, there can be but little doubt that the "large pool" referred to in the above note, was Jamaica pond.† The specimens you perceive are considerably smaller than those purchased in our market—

* Philosophical Transactions, Vol. 61, for the year 1771, p. 312.

† I have ascertained since writing the above, that Gov. Barnard's residence was on the borders of Jamaica pond.

all that I have seen from this pond for the last year, are smaller than those commonly met with. From the quantities yearly taken, however, they must have *increased considerably in number;* and their *flesh has lost nothing of its sweetness or flavor*, as I have repeatedly had opportunities of testing.

This is the only experiment, so far as I am able to learn, which has been made to transport marine fishes to fresh water, in our country. It has proved that this species can bear the change, and that it will increase in numbers in its new locality. In many ponds in our state more favorably circumstanced, better supplied with food, this fish would undoubtedly retain its usual size. In a highly interesting paper, entitled "Hints on the possibility of changing the residence of certain Fishes from salt water to fresh—by J. MacCulloch, M. D. F. R. S.," we learn that this same species, the *smelt*, has been kept by Mr. Meynell, of Yarm, Yorkshire, in a fresh water pond for four years, having no communication with the sea, and they *grew well*, and bred as freely as under other circumstances.* In the valuable communication of Dr. MacCulloch, just alluded to, several other species of fishes are mentioned as having been transported in a similar manner, and he observes that the flavor of every fish has been improved by the change. "The *sole* becomes twice as thick as a fish of the same size from the sea. The *plaice* also increases materially in thickness: in some cases, it appeared three times as thick as in the sea. The *barse* also turns much thicker, and improves in delicacy. The *mullet* almost ceases to grow in length, but enlarges in breadth, and presents a much deeper layer of fat."† No one can give this elaborate paper, which I have merely referred to, a careful perusal, without being satisfied that our own ponds, many of them now utterly useless, may be made rich repositories of numerous marine fishes.

Several instances might be referred to of fresh water fishes being transported successfully, not merely to neighboring ponds, separated from each other by a few miles, but also from countries even in very different degrees of latitude. The *Cyprinus carpio*, common carp, originally from the central part of Europe, is now distributed through almost all its ponds, rivers and lakes—and I have previously stated to this Society, that a pond in Newburgh, N. Y. was stocked with English carp.‡ The *Osphromenus olfax*, a native of China, has been introduced into the Isle of France, where it increases rapidly, and has been taken thence to Cayenne.§ The *Cyprinus auratus*, so

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* Quarterly Journal of Science, Literature and the Arts, Vol. 17, London, 1824. Also, Yarrell's British Fishes, Vol. 11, p. 77.

† Quarterly Journ. Science, Lit. and Arts, Vol. 19.

‡ Silliman's Journal, Vol. 36, p. 342. § Griffith's Cuvier, Vol. 10, p. 220.

generally known as the *gold fish*, the native of a lake in China, in about the 30th degree of latitude, has been introduced and naturalized in the Mauritius by the French, where they now abound in the fish ponds and streams; they are completcly naturalized, and are found in large numbers in many of the streams of Portugal, whence they are carried to England by trading vessels from Lisbon, St. Ubes, &c. in large earthern jars.* It breeds freely in small ponds and even in tanks in England.† Numerous ponds in Massachusetts abound with them, notwithstanding the severity of our winters.‡

The only instance with which I am acquainted of a fresh water species being removed from one sheet of water to another in this country, is that of the *Perca flavescens*, yellow perch ; and for this successful attempt we are indebted to the zeal and perseverance of the late Dr. Mitchill, of New York, whose paper on the Fishes of New York, published in the Transactions of the Literary and Philosophical Society of New York,§ is of great value to the American ichthyologist. He first published an account of his transporting the *perch* in the "Medical Repository,"‖ and afterward referred to it in his paper just spoken of. From the original statement I extract the following remarks: "In 1790, Uriah Mitchill, Esq., high sheriff of Queen's county, and myself went to Rockonkoma pond, in Suffolk county, a distance of about forty miles, in a waggon. The object of our journey was to transport alive some of the *yellow perch* with which this body of water abounds, to Success pond, in the town of North Hempstead. We took about three dozen of those which had been wounded most superficially by the hook, and were so fortunate as to dismiss all of them but two into Success pond, in a condition vigorous enough to swim away. We were enabled to do this by filling a very large churn with the water of Rockonkoma pond, and putting so few fishes into it that there was no necessity of changing it on the road, and afterwards driving steadily on a walk the whole distance, without stopping to refresh either man or horse. In two years these fishes multiplied so fast, and became so numerous, that they might be caught with the hook in any part of the water, which is about a mile in circumference."

I was unwilling the present opportunity should pass, without offering the Society some few facts to show the importance of the subject,—and would now close these hurried observations with the hope that we shall ere long be able to adduce successful experiments within the territory of Massachusetts.

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* Yarrell's British Fishes, Vol. 1, p. 316. † Ib.

‡ State Report on the Fishes of Massachusetts, p. 82.

§ Vol. 1, p. 422. ‖ Vol. 3, p. 422.

SCIENTIFIC INTELLIGENCE AND NOTICES OF BOOKS.

3. *Most Brilliant Meteor.*—On the evening of the 14th (August or July, 1839, old style, i. e. 26th, new style,) about 9 P. M., Capt. Pellegrines, being on the coast near Koutzolara, saw an extraordinary meteor toward the shores of Albania, Greece. A luminous body, which at first appeared like a common falling-star, crossed the sky from North to South; the blazing nucleus soon bursting forth with so much splendor that it eclipsed the stars, and turned night into day. It seemed as though the vessel would be burned up. The duration of the meteor was, as usual, very short; but when it disappeared it left behind it a long and broad fiery track, which, for the space of *twenty minutes, accurately noted*, sparkled like Bengal fire; until after an undulating motion, it curled up into the form of the letter Z, and by degrees ceased to be visible.

(Translated from the *Φιλος Του Λαου*, Athens, Sept. 18, [O. S.] 1839, p. 64, where it is quoted from the Journal of Corcyra, Corfu.)

4. *Explosion of a Meteor near Antigua, West Indies.*—The following account is taken from the *Dansk Westindisk Regierings Avis*, of Jan. 2, 1840.

"On Saturday morning, November 9, 1839, a little after daybreak, a concussion was felt in this town, preceded by a sound like the discharge of a heavy piece of ordnance, not far off, with blank cartridge, with reverberations; we thought it might be an earthquake. The impression was various in the town, it being an hour at which so few persons are awake: some thought it thunder; others, guns; and others, again, the explosion of one of the magazines at the forts at the mouth of the harbor. On inquiry in the course of the day, we heard that it was said by some servants and laborers, who were out soon, that it was *a star with a train of fire, which came from the eastward, passed over the town toward the sea, and burst in a blaze.* Anxious for all the information we could procure, we sent down to the fort, about three miles below the town, and at the south entrance to the harbor, to desire the chief signal man to report any observations he may have made on that morning. The following reply, coming from a person of great steadiness of character and intelligence, may be relied upon. It has been since fully corroborated by others, and especially fishermen, who were at sea at a very early hour that morning."

"Queen's Battery, Goat Hill, Nov. 11, 1839.

"I received your note yesterday about that ball or star. It was the case; about two or three minutes before James's fort fired the morning gun, this ball was seen about southeast of Goat Hill; it then darted along to a considerable distance westward; and immediately after it disappeared, there was an explosion as of great guns, in quick succession, *three times*, from the sky, with a quaking: the distance of time between each report was only about a second; and fifteen or twenty seconds after the whole, fort James fired its notice gun. These are my own observations, and of half a dozen respectable persons, who saw the whole, and on whose character I can depend for the truth, and who were so shocked at the time, that they betook themselves instantly to prayer."

5. *Splendid Meteoric Fire-Ball.*—On the morning of Wednesday, May 13, 1840, about 3 o'clock, a meteor of very uncommon splendor was seen in Connecticut, and in many places in the adjoining States. At New Haven, the illumination caused by the meteor was surprisingly vivid; but the person who saw the light, was prevented by a large building, from obtaining a view of the body. He could only perceive that its course was from S. E. to E. Accounts from Albany, N. Y., Boston, Mass., and other places, all agree in stating the light of the meteor to have been uncommonly powerful, and its apparent size nearly or quite equal to the moon at full. The accounts do not give the data necessary for determining the path, velocity, or size of this meteor, which was, undoubtedly, one of those from which stony masses are thrown down to the earth. The report of the explosion was, of course, much less distinctly heard here than in the eastern part of the State. Through the kindness of Mr. Gurdon Trumbull, of Stonington, I have received the following account of the occurrence from Capt. Comstock, of the steamboat Massachusetts, who happened to be near the scene of the explosion. It seems probable that when the meteor exploded, it was over the town of Westerly, in Rhode Island. E. C. H.

"The meteor observed on the 13th of May, at 3 A. M., bore at its starting point, (from my position, in lat. 41° 18′ N.; long. 71° 57′ W.,) about E. S. E. perhaps 60° above the horizon, and went with great rapidity on a course N. N. W. ½ W., at an inclination of about 30° towards the earth. When bearing N. E. or thereabouts, it partially exploded; the remainder (in appearance nearly as large as at first,) pursued the same course as before, until it descended within a short distance of the horizon, when it exploded with a report which I distinctly heard. At the time of its explosion, it bore N. N. E., perhaps a little more northerly. Its size appeared larger than the full moon. There was a brilliant train left behind, which retained its brightness some seconds after the main body had become entirely extinct. It may have been ten or fifteen seconds from the explosion until I heard the report, which led me to believe it was not far distant, and I drew the same conclusion from its extreme brilliancy, as it rendered the sea and land as light as at noon-day. It was a dark morning, and so sudden a transition to sun-shine, as it were, produced a spectacle truly grand. My position was four miles exactly south from Stonington, Conn., in a rather difficult passage between Nappertree point, so called, and Watch Hill reef. The light given out by this meteor was of great advantage, as it enabled us to ascertain the true position of our boat, and to take a correct departure to go through the passage. From the time of its commencement, until its light was entirely gone, may have been three and a half minutes."

JOSEPH J. COMSTOCK.

Providence, R. I., June 2, 1840.

6. *Alleged fall of a Meteor in Canada.*—A paragraph appeared in many of our newspapers in April, 1840, stating that a meteor, "judged to be about three times the size of an ordinary farm house," struck the earth, on the 17th [March?] near the house of Mr. John Daniels, Cook's Manor, U. C. The paragraph was credited to the *Sandwich Herald.* The Editor of this paper, on being written to for further information concerning the matter, replied that he knew nothing of the phenomenon, and was of opinion that the story is untrue.

7. *Auroral Belt of May* 29, 1840.—This Auroral belt, of which some account was given at page 194, was also seen at the Tippecanoe battle ground in Indiana, about 700 miles west of New Haven. It was, at that place, preceded by a brilliant display of the Aurora Borealis, and seems to have presented the same aspect there as here. The following description of the phenomenon, as observed at Nantucket, (N. lat. 41° 17',) was published by Mr. William Mitchell, in the Nantucket Inquirer of June 2, 1840:

"A display of the Aurora Borealis, in one of its most magnificent modifications, was witnessed in this place, [Nantucket,] on the evening of the 29th May last. During the evening, the twilight-form of the Aurora had been manifest along the northern horizon; from this, a zone of effulgent white light seemed to detach itself, extending from the east to the west point of the horizon, which moved towards the zenith, and passed that point, with a slow but uniform and majestic motion. This phenomenon, though somewhat less imposing, was, in most other respects, similar to that which excited so much attention, and created so much alarm in the autumn of 1827, [August 28.] On that occasion, the appearance was described by the various papers throughout a vast extent of our country, in a manner so strikingly similar, that no doubt could be entertained that it was one and the same object. This fact suggested to the writer of this article the possibility of calculating its distance from the earth, by noting the time, in various locations, in which it appeared to pass different regions of the heavens; and the result, though far from rigorously exact, afforded evidence, that while it partook decidedly of the motions of the earth, its elevation was more than five hundred miles. During the appearance of the zone on the 29th May, the time of its apparent contact with, and departure from the star Arcturus, then nearly in the meridian, was noted by a chronometer, with a hope that the same course would be pursued elsewhere, and thus detect its parallax. With this view, the periods are given below, in mean solar time at this meridian:

"Contact of the Southern border, 9 hrs. 36 min. and 46 sec. P. M.

"Departure of the Northern and better defined border, 9 hrs. 39 min. and 16 sec. P. M."

8. *Tornado at Northford, Conn., June* 19, 1794.—The following is taken from an interesting account of this tornado, sent to Rev. Dr. Stiles of Yale College, by Mr. Jonathan Maltby, who was not more than 100 rods distant when it passed by.

On Thursday, the 19th inst., P. M., passed over this place (Northford, Ct.,) a cloud, proceeding from S. W. to N. E., resembling the common thunder cloud, but of a light, smoky appearance, without rain or hail, and agitated beyond description. It was of a circular figure, whirling most violently upon its centre, its height and diametrical extent being about one eighth of a mile. From the midst of it issued a vortex of air, much in the form of an hour-glass, or similar to the vortex often seen in water, which descended to the earth. This figure alternately contracted and expanded from one to two rods, apparently, but really from ten to twenty. The *hour-glass* had constant communication with the cloud, from which it descended. When it contracted, it was less violent, but when it expanded, the scene was frightful, the fowls of the air, the herbage, fences, leaves, boughs and trunks of large trees, filled the atmosphere, whirling in every direction. Its progress was rapid and terrible, in a zigzag course, and attended with an alarming rumbling, somewhat like an earthquake. What is remarkable, on each side of it all was calm. A gentleman who sat in his stoop at the door of his house, scarcely felt it, while his barn, the width of the road from him, moved several feet from its foundation. The extent of the path of the tornado I have not ascertained.

9. *Method of permanently fixing, Engraving, and Printing from Daguerréotype Pictures:* by Dr. Berres, of Vienna.

The method of permanently fixing the Daguerréotype picture with a transparent metal coating, consists in the following process:—

I take the pictures produced in the usual manner, by the Daguerréotype process, hold them for some minutes over a moderately-warmed nitric acid vapor, or steam, and then lay them in nitric acid of 13° to 14° Reaumur, in which a considerable quantity of copper or silver, or both together, has been previously dissolved. Shortly after being placed therein, a precipitate of metal is formed, and can now be changed to what degree of intensity I desire. I then take the heliographic picture coated with metal, place it in water, clean it, dry it, polish it with chalk or magnesia, and a dry cloth or soft leather. After this process, the coating will become clean, clear, and transparent,* so that the picture can again be easily seen. The greatest care and attention are required in preparing the Daguerréotype impressions intended to be printed from. The picture must be carefully freed from iodine, and prepared upon a plate of the most chemically pure silver.

That the production of this picture should be certain of succeeding, according to the experiments of M. Kratochwila, it is necessary to unite a silver with a copper plate; while upon other occasions, without being able to explain the reason, deep etchings or impressions are produced, without the assistance of the copper plate, upon pure silver plate.

The plate will now, upon the spot where the acid ought not to have dropped, be varnished;† then held for one or two minutes over a weak warm vapor or steam, of 25° to 30° (Reaumur) of nitric acid, and then a solution of gum arabic, of the consistence of honey, must be poured over it, and it must be placed in a horizontal position, with the impression uppermost, for some minutes. Then place the plate, by means of a kind of double pincette, (whose ends are protected by a coating of asphalt or hard wood,) in nitric acid, at 12° or 13° (Reaumur.) Let the coating of gum slowly melt off or disappear, and commence now to add, though carefully and gradually, and at a distance from the picture, a solution of nitric acid, of from 25° to 30°, for the purpose of deepening or increasing the etching power of the solution. After the acid has arrived at 16° to 17° (Reaumur,) and gives off a peculiarly biting vapor, which powerfully affects the sense of smelling, the metal becomes softened, and then generally the pro-

* We do not well see how a film of metallic silver, however thin, can be transparent.

† This and some other passages, are a little obscure.

cess commences of changing the shadow upon the plate into a deep engraving or etching. This is the decisive moment, and upon it must be bestowed the greatest attention. The best method of proving if the acid be strong enough, is to apply a drop of the acid in which the plate now lies, to another plate: if the acid make no impression, it is, of course, necessary to continue adding nitric acid; if, however, it corrode too deeply, then it is necessary to add water, the acid being too strong. The greatest attention must be bestowed upon this process. If the acid has been too potent, a fermentation or white froth will cover the whole picture, and thus not alone the surface of the picture, but also the whole surface of the plate, will quickly be corroded. When, by a proper strength of the etching powers of the acid, a soft and expressive outline of the picture shall be produced, then may we hope to finish the undertaking favorably. We have now only to guard against an ill-measured division of the acid, and the avoidance of a precipitate. To attain this end, I frequently lift the plate out of the fluid, taking care that the etching power shall be directed to whatever part of the plate it may have worked the least, and seek to avoid the bubbles and precipitate, by a gentle movement of the acid.

In this manner, the process can be continued to the proper points of strength and clearness of etching required upon the plates from which it is proposed to print. I believe that a man of talent, who might be interested with this art of etching, and who had acquired a certain degree of dexterity in preparing for it, would very soon arrive at the greatest clearness and perfection; and, from my experience, I consider that he would soon be able to simplify the whole process. I have tried very often to omit the steaming and the gum arabic, but the result was not satisfactory, or the picture very soon after was entirely destroyed, so that I was compelled again to have recourse to them.

The task which I have undertaken is now fully performed, by placing in the hands of the public my method of etching and printing from the Daguerréotype plates, which information, being united to the knowledge and mechanical experience we already possess, and published to the world, may open a road to extensive improvement in the arts and sciences. By thus laying open my statement to the scientific world, I hope to prove my devotion to the arts and sciences, which can end only with my life.—*Atheneum*, (*London*) *May* 23.

10. *Cloth of Glass.*—Messrs. Williams and Sowerby of London, have been exhibiting, at the Annual Show of the Polytechnic Institution, (London,) their process by which glass first spun by steam

power, is woven by the loom into those sumptuous tapestries and rich hangings, which have excited the astonishment of all beholders. This curious manufacture alone is worth a visit to the Institution.—*Atheneum.*

11. *Death of Olbers.*—Henry William Matthew Olbers, M. D. etc. died at Bremen, on the morning of the 2d of March, 1840, in the 82d year of his age. He was born at Arbergen, duchy of Bremen, Oct. 11, 1758, and during a long life has been an industrious and successful cultivator of science. In 1802 he discovered the planet *Pallas*, and in 1807, the planet *Vesta.* His mathematical and astronomical labors, particularly those relating to comets, have been extensive and of the highest order. He retained and employed his exalted faculties far beyond the term usually allotted to man, and gently breathed his last, beloved and venerated by his friends and the whole scientific world.

12. *New fossil Shells from N. Carolina.*—Mr. T. A. Conrad, in a letter to the Editors, says,—

Having obtained a few interesting fossil shells from Duplin county, in North Carolina, I send you for publication descriptions of some species, I believe to be new. The formation is the same as that of Virginia, which I have termed Medial Tertiary. The fossils belong to my friend Daniel B. Smith, and were found by Professor Mitchell, of Chapel Hill, N. C.

Natica canrena.—This differs only from the recent specimens, in having the lines of growth on the spire more deeply impressed.

Fulgur excavatus.—Shell pyriform, with spiral lines, very prominent on the inferior half of the large whorl; shoulder of large whorl with a wide concave depression; spire widely and profoundly channeled; the whorls bicarinated, and slightly tuberculated on the carinæ. Length 3 inches.

Fulgur contrarius.—Shell sinistral, pyriform, with wrinkled spiral lines, obsolete on the middle of the large whorl, shoulder obtusely angulated, without spines or tubercles; summit of the whorls concave; whorls of the spire angulated in the middle, and slightly tuberculated on the angle; beak very long, sinuous; labium with distant prominent lines within. Length 4 inches.

Voluta Carolinensis.—Shell subfusiform; whorls deeply channeled below the suture; superior margin of the channel carinated; spire elevated, with prominent, rather distant acute spiral lines on the three or four superior whorls; large whorl with obscure, distant spiral lines, except towards the base, which is sulcated, and strongly striated. Length 3 inches.

Conus adversarius.—Shell sinistral, with obsolete spiral lines, except at base, where they are prominent; angle of body whorl, and base of the whorls of the spire carinated; the carina slightly tuberculated towards the apex; spire prominent. Length $2\frac{1}{2}$ inches.

Lucina jamaicensis, Lam.—This is a single valve, which differs in no respect from the recent specimens of the West Indies.

13. *Intelligence.*—The twelfth number of Mr. Conrad's Naiades has been published by Mr. J. Dobson, Philadelphia.*

Dr. Holbrook's fourth volume on North American Herpetology will soon appear.†

Dr. Binney of Boston is, we are informed, about to reprint his Monograph of the Helices, with plates, executed in the best style of art.

The Zoology of the State of New York.—It is the present intention of this commonwealth to publish the zoological portion of the survey, which has been making for three years past, in the most beautiful and elaborate manner. Every species, from mammalia to insects, to be engraved on steel plates—the insects to be described by Dr. Harris, of Cambridge, and the other departments by Dr. DeKay, the surveyor.

We hope this is only the dawn of liberal state and governmental patronage of science in this country, and that the day is not far distant when every State in the Union will follow the same example. On the return of our Antarctic Exploring Squadron, the general government will no doubt take pride in executing the scientific portion of their reports, in a manner equal to similar productions of England, and more particularly of France.

14. *Sorex parvus and Sorex brevicaudis.*—The Rev. James H. Linsley says in a letter to the junior Editor—*Dear Sir:* I would inform you that I discovered and caught the *Sorex parvus* of Say (small shrew) in the town of Darien, in this State, some time since. This is probably one of the smallest quadrupeds of the class mammalia, being but about two inches in length, and the tail three-fourths of an inch. I do not ascertain that it has ever been before seen east of the Mississippi. I would also add, that about a week since, (Aug. 25,) I found, drowned in a small cistern, at my house in this place, the *Sorex brevicaudis* of Say. The description in Dr. Godman's American Nat. Hist. is perfect, and answered in every particular to my animal, except that mine was $4\frac{1}{8}$ inches in length, and his $4\frac{5}{8}$ inches, including the tail, which was one inch in both. The division of the ear in this animal is a remarkable feature—the ear is nearly behind the head, divided in two parts, "*tragus* and *antitragus*," very white—the nose a livid brown color, quite remarkable—the teeth as

* See this Journal, Vol. xxix, p. 391. † See Vol. xxxv, p. 186.

black as night—all the four feet greatly resemble the human hand in shape, and are all white. Say supposes this to be what Barton calls the black shrew. I do not find it mentioned in Dr. DeKay's Report to the legislature of New York. Dr. Kirtland mentions it in his Report to the legislature of Ohio, as inhabiting that State, but adds, in a note, page 175, that "it does not agree with Mr. Say's description, and it may prove to be only a variety of the DeKayii."

I am gratified to add these two animals to the list of the mammiferous animals of Connecticut.

Elm Wood Place, Stratford, Sept. 3, 1840.

15. *The Natural History and Classification of Fishes, Amphibians, and Reptiles, or Monocardian animals:* by Wm. Swainson, F. L. S. &c. Vol. 2, (Lardner's Cabinet Cyclopædia,) 450 pages.

Mr. Swainson has given to the public a complete classification of reptiles, amphibians, and fishes, in this volume. Descriptions of the tribes, families, subfamilies, genera, and subgenera, could not, of course, be given at length in a work of this size; but the distinguishing characters are given in a few words, with great perspicuity.

The arrangement is sufficiently near that of Cuvier, but is varied for the purpose of showing the analogies of the various families. We were dissatisfied with this departure, until we saw the utility of it in pointing out the affinities, and simplifying the study of fishes. Mr. S. has given many original tables, showing the analogies of the different families, as the following:

Analogies of the Percinæ *and the* Serraninæ.

Genera of Percinæ.	*Analogies.*	Genera of the Serraninæ.
Perca.	Body oblong, or ovate; mouth horizontal, large.	Serranus.
Enoplosus.	Body short, roundish; mouth small.	Pentaceros.
Aspro.	Muzzle broad, projecting over the lower jaw.	Acerina.
Huro.	Mouth subvertical, large; lower jaw longest.	Grystes.
Apogon.	Tail much developed; eyes remarkably large.	Etelis.

Sub-genera of the genus Perca.	*Analogies.*	Sub-genera of the genus Serranus.
Perca. Cuv.	Pre-eminently typical; caudal fin forked.	*Serranus.* Cuv.
Lates. Cuv.	Body broad; caudal fin rounded.	*Chromileptes.* Sw.
Centropomus. Cuv.	Anal spines very large.	*Plectropoma.* Cuv.

Niphon. Cuv.	Lower jaw considerably longest.	*Cynichthys.* Sw.
Lucioperca. Cuv.	Tail greatly forked; eyes very large.	*Variola.* Sw.

The tables alone, prove that Mr. S. has studied ichthyology deeply, and the work should, therefore, be carefully studied by those who are interested in this branch of zoology. We object to *Perca* and *Labrax* being united, (as they are in the last table,) and think *Lucioperca* and *Perca* cannot be placed in the same genus. The *analogies*, however, would remain the same, were all the sub-genera elevated to genera. S. S. H.

16. *Natural History of the fresh water fish of Central Europe;* by Louis Agassiz: plates, folio, 1839, Neuchatel.*

The first livraison of this long promised work has at length reached us from its accomplished author. The beauty of the Poissons Fossiles led us to high expectations of this performance, and we are most happy to find that they were not vain.

The genera Salmo and Thymallus form the subject of this first division, to the illustration of which twenty-seven plates are devoted, giving each species from three to five plates. Thus Salmo Fario is represented in five different plates, showing the difference of age, sex, and locality, and presenting the fish as seen from above, on the side, and in a transverse section, taken before the ventral or dorsal fins; also the structure of the scales much magnified, and the position and anatomy of the fins. The descriptions are in French, German, and English, which arrangement must be of great service to the work, as well as to ichthyologists of different nations, who might not all be equally satisfied, if one language alone was used. The present livraison contains only the first division of the genera named above, and is to be soon followed by another, which will complete this monography; and then each succeeding livraison is to finish, as far as practicable, the monography of the genus of which it treats.

The first volume of text, which includes the natural history and anatomy of the Salmonidae, will appear with the second livraison of plates, which will include the species of the genus Coregon, and the anatomical details relative to this family.

The following is a list of the species figured in the present livraison: 1. Salmo salar, L., four plates, three of them colored. 2. S. Fario, L., five plates, four colored. 3. S. Trutta, L., four plates, three colored. 4. S. Umbla, L., four plates, three colored. 5. S. Hucho, L., three plates, two colored. 6. S. lacustris, L., three

* Histoire Naturelle des Poissons d'Eau douce de Europe Centrale, par L. Agassiz; planches. Neuchatel (Suisse) aux frais de l'Auteur, 1839.

plates, two colored. 7. Thymallus vexillifer, Ag., three plates, two colored. This work is to the fishes of Europe what Audubon is to the birds of America, a perfect iconography.

We are happy to state that two copies of it are on sale in the hands of M. Augustus Mayor, of New York, who has been before mentioned as the friend and correspondent of M. Agassiz,* and we hope that they will be speedily placed in the libraries of some of our societies, where they will be accessible to the student of this much neglected but most interesting branch of natural history. There are three prices for the first division, viz. on ordinary paper, 75 francs; on superfine paper, with selected plates, retouched with great care, 100 francs; on Bristol board, (*carton vélin,*) the most sumptuous impressions, 150 francs. This work is published at the expense of the author, and we hope that the public will, in this case, do what the British Association did for the Poissons Fossiles, indemnify him for the cost.

17. *Elements of Chemistry,* containing the elements of the science, both experimental and theoretical, intended as a text-book for academies, high schools and colleges; by Alonzo Gray, A. M., teacher of Chemistry and Natural History in the Teachers' Seminary, Andover, Mass. 1840—12mo. pp. 359.

A Manual of Chemistry, on the basis of Dr. Turner's Elements of Chemistry; containing in a condensed form all the most important facts and principles of the science,—designed as a text book in colleges and other seminaries of learning; by John Johnston, A. M., Professor of Natural Science in Wesleyan University, Middletown. 1840—12mo. pp. 453.

Both the above compilations made their appearance about the same time, and are both published with the same object—that of bringing the subject into a moderate compass, and within the means of all students. Unhappily for our reputation as advancers of science, almost all the works on chemistry which have yet been issued here, have been written *on the basis* of some foreign treatise. We hope the day is not far distant when American chemists will take a high rank as original investigators.

18. *Hitchcock's Geology.*—Elementary Geology, by Edward Hitchcock, Professor of Chemistry and Natural History in Amherst College, and Geologist to the State of Massachusetts. Amherst, 1840, pp. 329, small 8vo.

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* M. Mayor has also for sale two copies of the Echinodermata, of the same author. Vol. 35, p. 400. Vol. 37, p. 369.

Such is the unassuming title of a little volume, which has come to hand just as we are closing the present number. The readers of this Journal, and those who know the progress of American geology, are well aware of the important services Prof. Hitchcock has rendered to this branch of science, through a period of many years, both by his laborious explorations and his written works. We are happy also to add, that his transatlantic reputation is such, that no American name is considered of better authority in geology, or more highly esteemed.

In the present instance he has attempted to prepare a work which shall fill a vacancy long felt by the instructors of geology in this country, a work which, while it gives a good view of the progress of the science in other countries, draws its illustrations mainly from American facts. From the rapid glance which we have been able to bestow on this performance, we should think that Prof. Hitchcock had succeeded in imparting this feature to his book.

We subjoin an extract from the preface, which will give the author's own views in the composition of the volume, better than they can be expressed in other words. He says: "In preparing this work three objects have been kept principally in view: 1, to prepare a text book for my classes in Geology; 2, to bring together the materials for a synopsis of geology, to be appended to my final report on the Geology of Massachusetts, now in press; and 3d was, to present to the public a condensed view of the state of geological facts, theories and hypotheses, especially to those who have not leisure to study very extended works on this subject. In its execution the work differs from any with which I am acquainted, in the following particulars: 1. It is arranged in the form of distinct propositions or principles, with definitions and proofs; and the inferences follow those principles on which they are mainly dependent. This method was adopted, as it has long been in most sciences, for the convenience of teaching; but it also enables one to condense the matter very much. 2. An attempt has been made to present the whole subject in its proper proportion; viz. its facts, theories and hypotheses, with their historical and religious relations, and a sketch of the geology of all the countries of the globe, which have been explored. All geological works with which I am acquainted, either omit some of these subjects or dwell very disproportionately upon some of them. 3. It is made more American than republications from European writers, by introducing a greater amount of our geology. 4. It contains copious references to writers, where the different points here briefly discussed may be found amply treated."

The style of execution in the work is not equal to its value, particularly some of the wood cuts, (which are very numerous,) but these are minor considerations.

19. *Monograph of the Limniades, and other Fresh Water Univalve Shells of North America:* by S. S. Haldeman, Philadelphia. Judah Dobson, July, 1840. No. 1. 8vo.

The specimen number of a series bearing the above title, reached us last January, and was duly acknowledged in the list appended to the 78th number of this Journal.

The object of the work is to fill the space left unoccupied by the labors of Messrs. Lea and Conrad on the Unionidæ, and Mr. Binney on the Helices. The plates are executed in fine style, on copper, drawn by Miss Lawson, and colored very beautifully, with five or six examples of each species. The following species of Paludinæ are contained in the first number,—decisa, Say; subcarinata, Say; integra, Say; ponderosa, Say; genicula, Conrad. Mr. Haldeman describes five new Mollusca and parasitic animals, viz. Anculosa littorina, from Holston river, Va.; Cerithium (Potamis) Californicum, hab. California, Mr. Nuttall; Cyclas elevata, hab. near N. Orleans; Hirudo (Clepsina) scabra, found on Planorbis bicarinatus; Cercaria hyalocauda; parasite of Physa heterostropha. He also proposes to establish a new genus *Discus*, for the reception of Planorbis armigerus, Say; its characters are the same as Planorbis, with the addition of the teeth situated within the aperture of the shell. Each number will contain five plates and descriptions, and costs $1 per number, and may be had of Mr. Dobson.

20. *Leonhard's Geology.* (*Géologie des Gens du monde, par K. C. de Leonhard, conseiller intime, professeur a l'université de Heidelberg: traduite de l'Allemand sous les yeux de l'auteur, par P. Grimblot et P. A. Toulonzau. Tome deuxiéme, Paris et Stuttgart*, 1840, pp. 484, 8vo.)

This is the second volume of a series of three, in course of publication, by the celebrated author of the *Hand-book of Mineralogy*, and Editor of the Jarbuch für Mineralogie, &c. We have not seen the first volume, and are therefore unable to speak of it in connection with the present; but the second is evidently a continuation of the first, and not an independent treatise. It commences with an account of the prismatic divisions and vesicles of the volcanic and Plutonic rocks, and their action on the other rocks. He then proceeds in the usual order, through the superincumbent strata to the top of the coal. But the work is enriched throughout by every attraction of style and illustration, and the author has brought, to the elucidation of his subject, all the resources of a highly cultivated and accomplished mind. He is by no means confined to the mere technical details of his science, but draws interest from every source. Thus, at the conclusion of the Plutonic rocks, he gives an account of the mineral wealth of the gneiss, granite, and mica schist, and other rocks of this class; of their precious gems, and ornamental and architectural stones. There are two chapters on grottoes and caves, with an account of the ancient false ideas and suppositions concerning them, and their physical phenomena. The volume ends with a chapter on the mercury mines of the coal measures and other formations, and the metallurgic processes by which the metal is reduced from its ores.

Numerous well executed steel engravings are given, representing in many cases, views and scenery illustrative of his subject, which are not usually seen in works of this class. We believe that there is no one who would not feel himself both interested and instructed by its perusal.

21. *The* American Repertory *of Arts, Sciences, and Manufactures, embracing records of American and other patent inventions—accounts of Manufactures, Arts, &c.—observations on Natural History and Mechanical Science, &c. &c.* Edited by J. P. Mapes, Prof. of Chemistry and Natural Philosophy in the National Academy of Design, N. Y.

The first number of this journal made its appearance in *February* of the present year, and we are reminded, by the receipt of the concluding (sixth) number of the first volume, of our remissness in not sooner recognizing so valuable a contemporary. The prospectus states that it is intended peculiarly for the mechanics of this country, and the leading articles have had a corresponding character. Thus, a series of papers has been published "On the Art of Building," "Manufacture of white lead," "Mechanics' *vade mecum*," being tables of strength, weight, &c., with rules for the practical application of the same to the daily requisitions of the mechanic. Reports of the Mechanics' Institute are also given regularly, as well as those of several other societies, as the N. Y. Lyceum of Natural History, National Academy of Design, General Society of Tradesmen, &c.

This journal is so successfully applied to the elucidation of practical science, and its applications to the arts, that it seems peculiarly suited to the character of the American mechanic and practitioner, while the excellence of some of its original articles entitles it to the high consideration of all. These features will, we hope, ensure for the American Repertory an extensive patronage. We shall take pleasure in enriching our pages, as opportunity occurs, with miscellaneous extracts from it. It is published monthly in New York, at $4 per annum, and the first volume contains 483 pages.

22. *Principles of Statistical Inquiry, as illustrated in proposals for uniting an examination into the resources of the United States, with the census to be taken in* 1840; by ARCHIBALD RUSSELL. New York, D. Appleton & Co., 1839, 8vo. pp. 263.

Constitution and By-Laws of the American Statistical Association, with an Address. Boston, 1840.

This is a lucid statement of the chief points of interest, and the mode of making the investigation in a statistical history of the United States. It seems to have been written with a view of calling the attention of the general government to the importance of the subject, and of inducing the Secretary of State to adopt such measures as lie within his power, to combine with the census of the population the following interesting inquiries into—

1st. The products of Manufactures and Arts—viz. mines and minerals, manufactures of metals, manufactures on the loom, general manufactures. 2d. Agricultural statistics. 3d. Occupations in which the inhabitants are engaged. 4th. Place of nativity of the inhabitants. 5th. Vital statistics, i. e. the average duration and value of human life in the U. S. 6th. Crime. 7th. Pauperism. 8th. Education. 9th. Clergy. 10th. Taxation. For all these subjects plans of conducting the investigation are proposed, which seem to be well devised, and conceived in a philosophical spirit. It is certainly to be hoped that the general government, with whom alone rests the power of collecting accurate statistics, will faithfully discharge this most important subject; for it is evident that exact knowledge on the topics embraced in the present treatise will be of vastly more value than a mere numerical return of the inhabitants.

In connection with this subject, we have the pleasure of mentioning that a Statistical Society has been recently organized in Boston, called the American Statistical Society, and that they have issued their constitution and laws, and lists of members and fellows. Their objects are briefly stated in an address. They are associated and will coöperate with the foreign statistical societies at Paris, London, &c., by whose exertions the subject has been exalted into a science.

23. *Journal of the Academy of Natural Sciences of Philadelphia.* Vol. VIII, Part I. 8vo. pp. 171. Philadelphia, 1839.

The transactions of this Society have always been characterized by their scientific accuracy and permanent value. The Academy has been more fortunate than any other similar institution in this country, in enjoying, through a long course of years, the munificent patronage of the pioneer of American geology, the late and lamented William Maclure. They had just removed their library and collections to a new and elegant hall, erected at the expense of Mr. Maclure, when the news of his death in Mexico reached this country.

Dr. Morton is, we understand, drawing up an account of the life of this remarkable man, and when it appears we shall feel it our duty, as it is our pleasure, to do further honor to his memory.

The contents of the present part are as follows:

24. *Transactions of the Society instituted at London, for the encouragement of Arts, Manufactures, and Commerce,*—with premiums offered for the years 1838–9 and 1839–40. Vol. 52, Part II. London, 1839.

By the attention of its Secretary, we have been favored with a copy of the 2nd part of the transactions of the Society of Arts, &c. This society is conducted on the most liberal plan, and under its fostering care science has advanced in the most encouraging manner. Large premiums are annually offered and awarded, according to a list of subjects drawn up with great care. All inventions which are elicited in this manner, are thrown open for the free use of all, without patent, and the halls of the society contain models of all machines and contrivances which have ever come under its patronage.

The contents of the present volume are as follows:—

PART I.

Agriculture.—Colonel Le Couteur on Hoeing Wheat.

Fine Arts.—Mr. E. W. Whitehouse on making Casts from soft Anatomical Specimens; Mr. T. Carrick on Marble Tablets for Miniature Painters; Mr. J. Esquilant on Ornaments in Pressed Leather for Mouldings, &c.

Chemistry.—Mr. L. Thompson on Making Prussian Blue; on Purifying Copper; Messrs. G. and W. Bursill on a Safe Lamp, &c. for Miners.

Manufactures.—Mr. J. Farley on an Improvement in the Broad Silk Loom.

Mechanics.—Mr. J. F. Goddard on an Apparatus for exhibiting Experiments on the Polarization of Light; Mr. J. P. Paine on an Escapement Wheel and Micrometer Adjustment for Turret-Clocks; Mr. A. P. Walsh on a Remontoire Watch Escapement; Mr. H. Mapple on a Resonant Spring for Table-Clocks; Mr. F. Danchell on a Tuning Key for a Pianoforte; Mr. J. Crockford on a Ball-Valve for Shallow Water Cisterns; Mr. W. Baddeley on a Portable Tank for use at Fires; Mr. A. G. Edye on an Instrument for ascertaining the Stability of a Ship: Mr. W. Kennish on the disadvantages of the use of Black Paint on board Ship; Mr. J. Burkitt on a Self-Supplying Tympan; Mr. W. Levick on a Furnace for Type-Founders; Mr. A. Alexander on a Ventilating Eye-Shade; Mr. C. Jenkins on an Adjustable Step-Ladder; Captain Ericsson on a Hydrostatic Weighing Machine.

Illustrations.—On Artificial Light and the Manufacture of Candles, by the Secretary; The Natural History and Commercial History of Cotton, by Ditto.

PART II.

Agriculture.—George Aikin, Esq. on Improvements in the Culture of the Cambridgeshire Fens; W. Buchanan, Esq. on Cultivation of Potatoes.

Fine Arts.—Mr. R. W. Billings on Analysis of the East Window of Carlisle Cathedral; Mr. R. Redman on Transfers from Copper-plate to Zinc or Stone.

Chemistry.—Mr. J. T. Cooper on Preparation of Photogenic Paper; Mr. J. Marsh on new Test-liquor for Acids and Alkalies.

Colonies and Trade.—On Tea from Assam; on Bengal Silk; on Jungle Silk.

Manufactures.—Messrs. C. Hanchard, James Cole, J. Sodo on Improvements in weaving Wide Velvet; Mr. J. Dove on a Loom for weaving Silk Tissue.

Mechanics.—Mr. Jos. Jeay on Diagrams for finding the Lengths and Bevels of the Rafters in a Hip-roof; Mr. J. C. Bowles on raising Empty Casks; on a Putlog for Builders' Scaffolds; Mr. Benjamin Holmes on a Bolt-plate; Mr. W. Jones on a Travelling Platform; Mr. C. H. Page on Lettering Marble; Mr. M. Jennings on Night Signals for River Steamers; Mr. W. H. Thornthwaite on an Apparatus for Divers; Mr. James Hopkins on a Safety Scale-lever; Mr. J. Gray on Instruments for Extracting Teeth; Mr. J. L. Fenner on a Cupping-glass; Mr. A. Wivell on a Fire-escape; Captain J. Cookesley on a Raft.

Illustrations.—Mr. Andrew Ross on the Achromatic Telescope, (Part I. and II.); the Secretary on Horn and Tortoiseshell; on Bone and its Uses in the Arts; on Horn, Tortoiseshell, and Bone; Presents; Catalogue of the Models, Machines, &c.

25. *A System of Practical Medicine, arranged and edited by Alexander Tweedie, M. D.*, republished by Lea and Blanchard, R. 8vo. Philadelphia. Volume on Fevers and Diseases of the Skin. 1840. pp. 561.—This volume is one of a series of Medical Treatises, by various living authors, and edited by Dr. Tweedie. Each volume is, however, complete in itself, and is sold separately. The contents of the present are as follows:—*Introduction*, by Dr. J. A. Symonds; *Inflammation*, by Dr. W. P. Allison; *Fevers and Hectic Fever*, by Dr. R. Christison; *Plague, Intermittent Fever, Remittent Fever, and Yellow Fever*, by Dr. Thos. Shapter; *Infantile Gastric Remittent Fever, and Puerperal Fevers*, by Dr. Chas. Locock; *Small Pox*, by Dr. Geo. Gregory; *Measles and Scarlatina*, by Dr. Geo. Burrows; *Diseases of the Skin*, by Dr. H. E. Schedel.

26. *Lycopodium.*—On the morning of May 22, 1839, between 2 and 3 o'clock, a shower of rain was falling in Troy, (New York,) and soon after a yellow substance was observed on the tinned roof of a house, as well as on all the flat roofs in the vicinity,* and was washed off by the rain. The highly characteristic flash which it gives in the flame of a candle, resembling lightning, leaves no doubt of its identity with lycopodium, or at least of its belonging to the same family. The ground pine or club-moss is the humble representative of this family in modern times; none of the species ever attain a greater height than a few feet, whereas at the coal era there were trees of this family which attained a height of 60 or 70 feet in the stem.

Prof. Eaton and the botanists in Troy have probably long since determined from what source this yellow powder was brought by the winds. The specimen has only now arrived, or it would have been mentioned before.

The substance is probably a collection of the *sporules*, (or powder performing the office of seeds in the flowering plants) of the Lycopodium clavatum, or other species of the Lycopodiaceæ, (or *club mosses.*) These sporules are well known to be highly inflammable.

The above facts as well as the specimen have been communicated to us by the politeness of Mr. Avery J. Skilton, of Troy.—Eds.

27. *The burning of Monkton Pond, Vt.*—The following account was given me by Dr. Smith, of Monkton. He says his father, brother, and himself were burning briars early in the spring near the pond, and in an instant the pond took fire with a terrible roar; in a fright, they fled away from it, and when they looked back they saw the blaze to rise many yards high, and although it was a calm day, and the pond still till that moment, the water became agitated in great waves, and the roaring of the fire was heard several miles. Dr. Smith was a man of strict veracity, and the statement of facts can be relied on. He says the blaze settled lower and lower till it was extinct.

S. Fansher.

28. *Bone Cavern.*—Extract of a letter to the Editors from Mr. W. Gaylord, dated Otisco, N. Y., Aug. 3, 1839.

" *My dear Sirs*—In looking over a Philadelphia paper a few days since, I saw it stated that a cave had been lately discovered on the bank of the Susquehannah, in constructing the railroad near Harrisburg, and in noticing it, the Harrisburg Keystone states 'that its depth is about 20 feet, its extent unknown. *Bones of various kinds*

* There is an account in Dr. Mitchill's Med. Repos. (Vol. 3, p. 414,) of a yellow deposit from rain, which fell at New York, April 12, 1800.

and sizes have been found in it, and the spoils of the cave, we are told, would be a very valuable addition to the collection of the curious antiquarian.'

"As bones, I believe, have rarely been found in caves in this country, though common in Europe, and deemed of great importance in settling the geological character of a country, I thought I would bring the above to your notice, if it has not already been done, as you have probably some correspondent in that vicinity, who would at your request, examine the premises, secure the bones, or make such a report as would be interesting to the readers of your Journal, and important to the cause of science."

Mr. Gaylord remarks that the average temperature of June and July has been about 7° lower than that of the corresponding months of last year.

We request information respecting this cavern and its osseous contents.—Eds.

29. *Case of Transpiration of half the body.**

Fort Hamilton, New York, Nov. 25, 1837.

Prof. Silliman—*Dear Sir*—In 1834 I called the attention of the scientific community to an anomalous case of cutaneous transpiration which presented itself in the person of a friend of mine, a merchant of Baltimore. The particulars of the case were published in the "Medical Library," a journal conducted by Prof. Pattison, and copied from thence into the "Transylvania Journal of Medical Sciences;" but the explanation of the phenomenon attempted by the editor was to me unsatisfactory. Will you oblige me by giving the 'case' a place in your Journal, with such comments as its perusal may suggest.

The merchant referred to, from his earliest youth enjoyed a marked immunity from disease; and assured me that from infancy to the moment at which he spoke, his "sweating" was confined to one side of his body. The right side of his scalp, the right side of his face, right side of his thoracic, hypochondriac, iliac, lumbar, and pelvic regions, right thigh, leg, and foot, were frequently saturated with the matter of perspiration, whilst their corresponding opposites maintained an unvarying aridity. My intimacy with him afforded me repeated opportunities of observing the phenomenon. It was often a subject of merriment with him, and never one of the least concern. Could paralysis of the exhalents of the opposite side have existed without other morbid manifestations? I think not.

Very respectfully, your obedient servant,

Lucius O'Brien, *Lieut. 3d Reg. U. S. Infantry.*

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* This fragment would have appeared before but for the expectation of hearing again from the writer of the letter, in answer to certain inquiries addressed to him in a letter hitherto unanswered. Being unable to suggest any satisfactory explanation, we must refer the case to our medical friends.—Eds.

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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.

Géologie des Gens du Monde, par K. C. de Leonhard de Heidelberg; translated from the German by P. Grimblot and P. A. Toulougan. Tome deuxième. Paris, 1840. From the Author.

Lethea Geognostica; feuilles 13 and 14 of text, and Taf 13, 14, 16, 17, 18, 20, 21, 23 and 24. From the Author.

Neues Jahrbuch für Mineralogie, &c. 1833, Heft. 1 and 6. 1838, Heft. 1, 4, 5, 6. From Messrs. Leonhard and Bronn.

Several German Catalogues of Books, for sale by Nestler & Melle, Hamburg. From N. & M.

Histoire Naturelle des Poissons d'Eau Douce de L' Europe Centrale, par L. Agassiz. 1 Livraison, contenante les Salmones, folio, with beautiful colored plates. From the Author.

Monographie des Echinodermes vivans et fossiles, par L. Agassiz. Neuchatel. 1er Livraison. From the Author.

Transactions of the Society for the Encouragement of Arts, Manufactures, &c. 1839. Vol. 52, part II. From the Society.

Report on A. M. Perkins's Patent Steam Boiler, by J. Parkes, Civil Engineer. Lond. 4to. 1840. From Mr. Wheelwright.

Transactions of the Royal Society of Edinburgh, Vol. 13, pt. 1. From the Society.

Anniversary Address of the Duke of Sussex, before the Royal Society, Nov. 30, 1837. 8vo. Lond. From Dr. Mantell.

List of the Geological Society of London. March 1, 1839. From the same.

Notes on the Age of the Limestones of South Devonshire, by Wm. Lonsdale, F. G. S. 1840. From Dr. Mantell.

Catalogue of Adelaide Gallery of Practical Science for 1837. Lond. From Dr. Mantell.

Lithographic Figures of Fossils from the London Clay on Wadsworth Common. From Mr. G. A. Mantell.

Die Phänomene der Geologie leichtfasslich in Vorlesungen entwickelt von Dr. Gideon Mantell: Deutch herausgegeben von Dr. Joseph Burkart. 2 Bande. Bonn, 1839. From Dr. Mantell.

Bericht über den Verein zur Verbreitung von Naturkenntniss und höherer Wahrheit aus dem Jahr 1827 and 1828. Vom Dr. J. S. C. Schweigger. 12mo.

Icones Plantarum, by Sir Wm. Jackson Hooker, KH. London, 8vo. pt. VI, 1840. From the Author.

The Wonders of Geology, by Gideon A. Mantell, LL. D. F. R. S. 2 vols. Fourth Edition, 1840. London. From the Author.

On the discovery of Fossil Teeth of a leopard, bear, and other animals in a crag-pit, at Newbrurn, in Suffolk, by Charles Lyell, Esq., F. R. S., &c. From the Author.

On the occurrence of Fossil Quadrumanous, Marsupial, and other mammalia in the London clay, near Woodbridge, in Suffolk. By and from the same.

Description of the mammalian remains found at Kyson, in Suffolk, mentioned in the preceding notice by Richard Owen, Esq., F. R. S., &c. From the same.

Proceedings of the Royal Society, No. 40, Nov. 1839. With the address of the President, the Marquis of Northampton. From the same.

Sur la Longitude de l'Observatoire Royal de Bruxelles, par A. Quetelet, Bruxelles. 4to, 1839. From the Author.

Sur l'Etat du Magnétisme Terrestre a Bruxelles pendant les douze années de 1827 à 1839, par A. Quetelet. 4to, 1839. From the Author.

Bulletin de l'Acad. Royale de Bruxelles. Tom. 6, No. 12. Meteorologie, &c., 8vo. From A. Quetelet.

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Aperçu de l'état de l'Observatoire pendant l'année 1839, par A. Quetelet. 8vo. Bruxelles. From the author.

Premier Mémoire sur les Kaolins, ou Argiles à Porcelaine, sur la nature, le gisement, l'origine et l'emploi de cette sorte d'Argile. Par M. Alex. Brongniart, de l'Acad. Roy. des Sci. 4to. Paris, 1839. From the Author.

Tableau de la distribution méthodique des Especes Minérales, etc. Par M. Alex. Brongniart, Professeur. 8vo. Paris, 1833. From the Author.

Catalogo de Minerali Esotici della Collezione del Cav. Monticelli. 4to. Italy. From Jas. Hall.

Extracts from a Memoir on the Geological Structure and Phenomena of the County of Suffolk, &c. by Rev. W. B. Clarke. From the Author.

On the results of an Extensive System of Tide Observations made on the Coasts of Europe and America, in June, 1835, by Rev. W. Whewell. Phil. Trans. 1836, 4to. Lond. From the Author.

On the Temperatures and Geological Relations of certain Hot Springs, particularly those of the Pyrenees; and on the Verification of Thermometers, by Jas. D. Forbes, Esq. Phil. Trans. 1836. 4to. From the Author.

Recueil d'Observations Magnétiques et Meteorologiques faites dans L'Russie, anne 1837, par A. T. Kupffer. 4to. St. Petersburgh. From M. Kupffer.

The hand-book of Chemistry, by G. H. Cannter. London, W. S. Orr, Amen Corner. 8vo. pp. 280. From the Author.

Account of an intermitting brine spring discharging carbonic acid gas, near Kissengen in Bavaria. By and from Prof. Forbes. 8vo. pp. 21. Edinburgh New Phil. Jour.

On the color of Steam under certain circumstances, and on the colors of the Atmosphere. By and from James D. Forbes, F. R. S., &c. 4to. pp. 20. Edinburgh, 1839.

On the ages of the Tertiary Deposits, commonly called crag, in the Counties of Norfolk and Suffolk. By and from C. Lyell, Esq.

Proceedings of London Geological Society, No. 62. From the Society.

Voyages of the Adventure and Beagle, Journal and Remarks, by Mr. Charles Darwin, Sec. Geol. Soc. From the Author.

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Supplement to the introduction to Atomic Theory, by Charles Daubeny, M. D., F. R. S., &c. London.

Sketch of the Geology of North America, by Charles Daubeny, M. D. 8vo.

Communication faite a la Societé Philosophique Américaine dans une des Séances de 1839, au sujet des Trombes, par Robert Hare, M. D., Philad.

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Traité Elémentaire de Conchyliologie, par G. P. Deshayes. Paris.

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Consumption curable, &c., by F. H. Ramadge, M. D. From J. L. Sullivan, M. D.

Statistics and Philosophy of Storms, from the Edinburgh Review for Jan. 1839.

Catalogue des Principales Apparitions d'Etoiles Filantes, par A. Quetelet, Directeur de l'Observatoire de Bruxelles. 4to. pp. 63. Bruxelles. From the Author.

SCIENCE.—DOMESTIC.

Transactions of the Amer. Philos. Society. Vol. 6, New Series. pt. 3, 4to. From the Society.

Journal of the Academy of Natural Sciences of Philadelphia. Vol. 7, pt. ii, 1837, and Vol. 8, pt. i, 8vo. From the Academy.

Reports of Prof. C. U. Shepard, and Forrest Shepherd, Esq., respecting mineral deposits in the States of Missouri and Arkansas. Accompanied by a Map. 8vo. One also for B. Silliman, Jr. From the Authors.

Second Annual Report on the Geological Survey of Ohio, by W. W. Mather, Principal Geologist, and the several assistants. 8vo. Columbus, 1838. From Dr. John Locke.

Annual Reports of the Geologists of the State of New York, Jan. 24, 1840. Doc. No. 50, pp. 484. From Prof. E. Emmons. One do. for B. Silliman, Jr. From Jas. Hall, Esq.

Maryland Medical and Surgical Journal, and Official Organ of the Medical Department of the Army and Navy of the U. States. Vol. I, Nos. 1 and 2, 1840. From the editors.

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Proceedings of Pres. and Fellows of Conn. Medical Society in Convention, May, 1838. Hartford.

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Phrenology, a lecture delivered before the Woodville Lyceum Association, by Prof. Mariano Cubi Y. Soler.

History and Progress of Phrenology, two Lectures delivered before the Western Phrenological Society, by R. W. Haskins. Buffalo, 1839. 8vo. pp. 217. From the Author.

Report on the Geological Survey of Michigan, from Dr. Dougass Houghton, State Geologist.

A Manual of Chemistry on the basis of Turner, by Prof. John Johnston, of the Wesleyan University, Middletown, Conn.

Elements of Chemistry, containing principles of the science, &c., by Alonzo Gray, A. M., teacher of chemistry and natural history in the Teachers' Seminary, Andover, 1840. Small 8vo. pp. 359. From the Author.

Hitchcock's Geology. Elementary Geology, by Prof. Edward Hitchcock. Amherst, 1840. Small 8vo. pp. 320. From the Author.

Proceedings of Am. Phil. Society, Nos. 9 and 10, 2 copies, one from the Society, and one from Dr. Hare.

The Homœopathic Examiner, by A. G. Hull, M. D. Vol. 1, Nos. 1 and 2, Jan. and Feb. 1840.

Examination of some of the Anthracites of Pennsylvania. By and from Prof. W. R. Johnson.

A full description of the Daguerreotype process, as published by M. Daguerre, from the Am. Repertory, edited by Prof. J. Mapes. From Dr. J. R. Chilton, N. Y.

Annual Report of the Geological Survey of Virginia for 1839.

Transactions of the Essex Agricultural Society for 1839. From Henry Colman.

Fifth Geological Report of Tennessee for 1839. From. G. Troost, M. D.

Geological Report of the State of New York. From L. Vanuxem. Do. from James Hall.

American Repertory of Arts, Sciences, and Manufactures, edited by J. P. Mapes.

First Report of the Geological Survey of New Brunswick, by Abraham Gesner. From the Author.

Report of the Examination of the Coal Field of Carbon Creek, by W. R. Johnson, A. M.

Spinal Irritation, by J. H. Griscom, M. D., New York. From the Author.

A System of Practical Medicine, comprising a series of original dissertations, arranged and edited by Alexander Tweedie, M. D. F. R. S., Fellow of the Royal College of Physicians. Fevers and Diseases of the Skin. Philadelphia, 1840. Lea & Blanchard, publishers.

North American Botany, by Eaton & Wright. 8th ed. 8vo. pp. 625. Troy, N. Y. 1840. From E. Gates, publisher.

Remarks on the Geology and Mineralogy of Nova Scotia, by Abm. Gesner, Esq. Halifax, 8vo. From the Author.

Inquiry concerning the diseases and functions of the Brain, Spinal Cord, and the Nerves, by A. Brigham, M. D. 12mo. From the Author.

MISCELLANEOUS.—FOREIGN—BOOKS AND NEWSPAPERS.

Letters to the Shareholders of the Great Western Railway, London, 1838.

Catalogue de la Libraire d'Auguste Desrez, Janvier, 1840. Paris. From W. and P.

The Publishers' Circular, from Wiley & Putnam.

Catalogue of Books. From Wiley & Putnam.

Publishers' Circular, 9 numbers. From Wiley & Putnam.

Twentieth Annual Report of the London Provident Institution.

Foreign Monthly Review for May, July and August. London.

Twenty Third Annual Report of the London Provident Institution.

Statements and Documents relative to the establishment of Steam Navigation in the Pacific. 12mo. Lond. From Mr. Wheelwright.

The Colonial Pearl, Halifax, N. S., May 23, 1840.

Western Herald, Sandwich, U. C., May 6, 1840.

Telegraph and Texas Register, Houston, May, 1840.

Galignani's Messenger, Paris, May 4, 1840. Earthquakes in Scotland, 1839, also several other Nos. of this paper, from S. H. Walley, Esq., Paris.

Royal Gazette and Newfoundland Advertiser, Nos. 1671-4, with Report on the Geology of Newfoundland, by J. B. Jukes, F. G. S. St. Johns, 1840.

Sussex Advertiser, Lewes & Brighton, March, 1840. From Dr. Mantell.

Verzeichniss der Vom Juli bis December, 1839, herausgegeben Neuen Bücher. No. 52, Hamburg. From Perthes & Besser.

The Liverpool Journal, May 10, 1840; temperance in Ireland, and murder of Lord Wm. Russell.

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London British and Foreign Anti-Slavery Rep. July 1, 1840.

London Morning Herald, June 22, 1840. Trial of Courvoisier.

London Sun, June 20 and 23, 1840; British and Foreign Anti-Slavery Society, and attack on the Queen.

London Sun, Feb. 10, 1840, with medallion portraits of Queen Victoria and Prince Albert. From S. H. Walley, Esq., at Paris.

South African Advertiser, Cape of Good Hope, Dec. 27 and 11, 1839, two large folio papers; notice of the Cold Bokkeveld meteorite of October, 1838. Rev. G. Champion, Bokkeveld.

The Chinese Repository, Canton, Vol. 8, Nos. 9, 10, 11. From the editor.

Syllabus of the course of lectures on Chemistry, delivered in King's College, by J. F. Daniell, F. R. S., 1836.

MISCELLANEOUS.—DOMESTIC.

Speech of Mr. Slade, of Vt., on the right of petition, &c., Washington, delivered before the House of Representatives, Jan. 18 and 20, 1840. From Joseph Trumbull, Esq., M. C.

Message from the President of the U. States, transmitting Hon. J. R. Poinsett's communication on the internal improvements carried on by the General Government. From J. Trumbull, Esq., M. C.

A bill to provide for the better security of the lives of passengers on board Steam Vessels propelled in whole or in part by Steam. From Hon. Mr. Ruggles, U. S. Senate.

The Peru Gazette, Ind. March 7, 1840, containing an extract from a Meteorological Journal. By and from Horatio Waldo, Jr.

The Millennium Oracle, a sacred drama, by E. P. Page. Marietta, Ohio, 1840. From the Author.

Twenty first Annual Report of the N. Y. Institution for instructing the Deaf and Dumb. N. York, 1840. From Mr. H. P. Peet, A. M., Principal.

Albany Daily Advertiser, March 12th, 1840, and Smithsonian Legacy Memorial in relation to a National Agricultural Institution. From C. Morgan, M. C.

Boston Atlas of March 27, "on the Hair-istocracy."

Albany Daily Advertiser of March 12, containing abstracts of proceedings of Albany Institute. From Dr. Beck.

Banks and Currency. From Mr. Gardner, of Troy.

Address and Suppressed Report of the minority of the Committee on Elections on the New Jersey case. From Hon. Wm. L. Storrs, M. C. Washington, D. C.

Catalogue of a Private Library, sold March 18, 1840. By and from Messrs. Bangs, Richards & Platt.

Memoir Historical and Political of the northwest coast of North America, by Robert Greenhow. From Hon. J. Davis.

Thirtieth Annual Report of the Commissioners for Foreign Missions.

Chancellor Kent's course of Reading. From the Directors of the Mercantile Library Association, New York.

Memorial on the impolicy and injustice of certain enactments contained in the law relating to steamboats. From W. C. Redfield.

Account of the Yellow Fever in Galveston, Texas, in the autumn of 1839, by Ashbel Smith, M. D. From the Author.

On the study of the Celtic Languages, by Rev. A. B. Chapin. From the Author.

Notice of the Daguerreotype, by Wm. E. A. Aikin, M. D. From the Author.

Second Annual Report of the Board of Commissioners of Common Schools, 1840. From H. Barnard.

Memoir of Mrs. Elizabeth Adams, by Moses Stuart.

Remarks of the Hon. Peleg Sprague, on the character and services of Gen. Wm. Henry Harrison.

Catalogue of the Officers and Students of the Oberlin Collegiate Institute. From Henry Cowles.

Catalogue of Cliosophic Society of the College of New Jersey. From Eli Whitney.

Letter to the Hon. Theodore Frelinghuysen and Hon. Benj. F. Butler, on the consideration of the Colonization scheme, by S. E. Cornish and Theo. S. Wright. From the Authors.

Address to the Medical College of South Carolina, by J. Moultrie, M. D.

Catalogue of the Medical College of S. Carolina, for 1839–40.

Sermon on the death of John Lowell, LL. D., by F. W. P. Greenwood. Boston, 1840.

Proceedings of the Connecticut Medical Society, May, 1840.

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Mohawk Courier, with account of earthquake at Little Falls.

The Constitution, with an account of the canker-worm moth. By J. Barratt, M. D.

Prospectus of Faculty of Physic of the Univ. of Maryland.

Speech of Mr. Brockway of Connecticut on the Sub-Treasury Bill. From the Author.

Speech of Mr. Osborne of Connecticut on the Sub-Treasury Bill. From the Author.

Collections of the Georgia Historical Society, 8vo. Vol. I. From the Society.

Collections of the Rhode Island Historical Society. Vol. 4, 8vo. From Lieut. Wm. Rogers Taylor.

Report on Education in Europe, to the Trustees of the Girard College for Orphans. By A. D. Bache, LL. D., President 8vo. Philad. From the Author.

Discourse embracing the Civil and Religious History of Rhode Island, delivered April 4, 1838, 2d century from settlement of the island. By Rev. Arthur A. Ross. Prov. 12mo. From Lieut. W. R. Taylor.

Battle of Lake Erie, with Notices of Com. Elliott's conduct in that engagement. By Hon. T. Burges, 12mo. From Lieut. W. R. Taylor.

Discourse on Life and Character of President Kirtland, by Alex. Young. Boston. From the Author. One also for Library of Yale College.

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Rev. Mr. Rogers's Sermon occasioned by the loss of the Harold and the Lexington. Boston. From J. C. Proctor.

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Speech of Mr. Osborne of Conn. on Sub-Treasury Bill, June 3, 1840, House of Rep. From Hon. W. L. Storrs.

Speech of Mr. Brockway on the same, June 2, 1840. From Hon. W. L. Storrs.

Speech of Wm. Cost Johnson, of Maryland, on the rejection of petitions for the Abolition of Slavery, House of Rep. Jan. 1840.

Report of the Secretary of State on the subject of the law for taking the 6th census of the U. States.

Memoir, historical and political, on the northwest coast of North America, &c. with a map, by Robert Greenhow, translator and librarian to Dept. of State. 26th Congress, 1st session. Feb. 10, 1240. From Hon. J. Davis.

Memorial of the Committee of Tobacco Planters, to 26th Cong. U. S. Doc. 198. From Hon. J. Trumbull.

Catalogue of Westfield Academy, Mass. 1839–40. From Mr. A. Parish.

Address before the Faculty and Students of Emory College, Oxford, Ga. By A. H. Longstreet, President, at his inauguration, Feb. 10, 1840.

Catalogue of rare and curious Old Books, for sale by Bartlett & Welford, New York City.

Water from the White Sulphur Springs, Greenbriar Co., Va., &c. &c., by J. J. Mooman, M. D.

The Bow of Promise, an Address, by the Rev. John Marsh, July 4, 1840, before the Marine Temperance Society, N. Y. From the Author.

Catalogus Collegii Dartmuthensis, 1840. From Prof. O. P. Hubbard.

Report of the case of Taylor vs. Delavan, for libel. Albany, 1840.

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Annual announcement of the Jefferson Medical College at Philadelphia, with a Catalogue of graduates. 1840.

Catalogus Collegii Hamiltonensis, 1840. From Rev. President S. North.

Report of the select committee on the Geol. Survey, of N. York, in Assembly April 28, 1840, No. 338. From James Hall.

Report of the minority of the Committee of Elections on the *New Jersey contested election.* From Hon. W. J. Hastings, M. C.

The Mad Dog, or Hydrophobia. From Dr. Lewis Feuchtwanger, New York.

Yankee Land and the Yankee—Poem by and from the author, Daniel March, A. B.

Philosophy of Mind, by John Stearns, M. D. N. Y. 1840. From the Author.

Address of the Philomathean Society of Mount St. Mary's College, Maryland, by Eugene H. Lynch, Esq., Baltimore. From the Society.

Specifications of the materials and construction of Susquehannah division of the New York and Erie Rail Road. From D. V. Macumber, Esq.

History of the Lehigh Coal and Navigation Company, with Maps, 3 copies. From J. Watson, Jr., Esq.

Catalogue of the Officers and Students of the Medical College of the State of South Carolina. From T. L. Bender.

The real nature of the Electric Fluid, and the Polarity of the Magnet explained. From the author, James Glenn.

Original and galvanic copy of a print, both beautiful and quite identical. From an unknown source, supposed New York.

A folio printed page on the ten tribes of Israel and the aborigines of America. New Albany, Indiana.

SPECIMENS.—DOMESTIC.

A few seeds of choice culinary vegetables. From L. Stone, Esq., Derby.

Secondary Fossils from Indiana, Spiriferæ, Terebratulæ, Favosites, Madraporæ, &c. From Dr. Plummer.

A medallion of copper, precipitated by the process of Prof. Jacobi, prepared by Prof. Jos. Henry, of Princeton. From Prof. H. Also another from Mr. Jos. Saxton, U. S. Mint at Philad.

Species of fresh water and land shells, for the Yale Nat. History Society. From John Anthony, Esq., Cincinnati, Ohio.

Iron and copper ore, and a few minerals from Cornwall furnace, five miles south of Lebanon, Pa. From John Reynolds, Esq.

Fossils of the Tertiary of Scriven county, Georgia, chiefly casts of Shells. From Mr. Thomas R. Dutton.

Quartz crystals from Little Falls, New York. From Mr. J. W. Douglass.

SPECIMENS.—FOREIGN.

Ammonites and trigoniæ from the Sub-Himalayeh mountains, collections of Capt. Cautley. From Dr. G. A. Mantell.

Sample of the gold ore or matrix, from Jabani, near Seembus, Borneo. From Rev. Mr. E. Doty, Missionary; forwarded by kindness of Rev. Dr. Ball, Singapore.

Mineralogical and Geological specimens from Palestine. From Rev. Mr. Hibbert—a very interesting suit of specimens historically and scientifically.

NEWSPAPERS.—DOMESTIC.

Commercial Advertiser and Journal, Buffalo, June 2, 1840; with notice of floods of the Mississippi. From Mr. R. W. Haskins.

Yankee Farmer, Boston, edited by Mr. S. W. Cole. 1840.

Com. Adv. and Journal, Buffalo, May 23, 1840; with notice of inclination of earth's axis to the ecliptic. From R. W. Haskins.

Ohio Observer, Hudson, Ohio, July 9, 1840; with Meteorological Journal, June, 1840, kept at Western Reserve College, by Prof. Loomis.

Citizen Soldier, Norwich, Vt., July 29, 1840. J. Richards, publisher. Vol. 1, No. 2.

New England Weekly Review, Hartford, July 11, 1840; with notice of Torrey's & Gray's Flora of North America; by Dr. Joseph Barratt.

The Disseminator, New Harmony, Ind., May 7, 1840.

Ohio Republican, Zanesville, May 23, 1840.

Salem Observer, June 27, 1840; with notice of Essex Co. Nat. Hist. Society.

Literary Advertiser, Prospectus of the National Society of Literature and Science, N. Y. June, 1840.

Eastern Argus, Portland, April 30, 1840.

North American, Philadelphia, April 28, 1840. From Mr. B. B. Thatcher.

Boston Journal, April 30, 1840.

American and Foreign Anti-Slavery Reporter, New York, 1840.

National Gazette, Philad. July 14; with a notice of the storm of the 13th.

Boston Mercantile Evening Journal, Friday, Aug. 7, 1840; with a notice of the article on Phrenology in the 79th No. of the Am. Jour. Science. Editors.

The Christian Citizen, Boston, May 1, 1840. Vol. 1, No. 1. From the Editors, J. & G. Stearns.

Louisville Literary News Letter. Nos. 1 to 36.

Boston Mercantile Journal, Aug. 20, 1840. From the Editors.

Lowell Journal, Aug. 22; containing notice of "Bang up Novelties."

The New World, by Park Benjamin, Esq., Aug. 22; containing an account of the steamer President, with a "portrait" of that vessel.

Boston Mercantile Journal, Aug. 20, 1840. Earthquakes.

New York American, Aug. 26, 1840. Mr. Webster's Speech at Saratoga.

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