THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and For. Mem. Geol. Soc., London; Mem. Geol. Soc., Paris; Mem. Roy. Min. Soc., Dresden; Nat. Hist. Soc., Halle; Imp. Agric. Soc., Moscow; Hon. Mem. Lin. Soc., Paris; Nat. Hist. Soc. Belfast, Ire.; Phil. and Lit. Soc. Bristol, Eng.; Hon. Mem. Roy. Sussex Inst. Brighton, Eng.; Lit. and Hist. Soc., Quebec; Mem. of various Lit. and Scien. Soc. in America.

VOL. XXXII.—~~JULY~~, 1837.

NEW HAVEN:

Sold by A. H. MALTBY and HERRICK & NOYES.—*Baltimore*, I. SMITH HOMANS, (late E. J. COALE & Co.)—*Philadelphia*, CAREY & HART and J. S. LITTELL.—*New York*, G. & C. CARVILL & Co., No. 73 Cedar St., and G. S. SILLIMAN, No. 45 William St.—*Boston*, HILLIARD, GRAY & Co.

PRINTED BY B. L. HAMLEN.

CONTENTS OF VOLUME XXXII.

NUMBER I.

		Page.
Art. I.	General Remarks on the Temperature of the Terrestrial Globe and the Planetary Spaces; by Baron Fourier,	1
II.	Account of an Excursion to Mount Katahdin, in Maine; by Prof. J. W. Bailey, - - - - - - -	20
III.	Experiments on the Adhesion of Iron Spikes of various forms, when driven into different species of Timber; by Prof. Walter R. Johnson, - - - - -	34
IV.	Remarks on the Natural order Cycadeæ, with a description of the ovula and seeds of Cycas revoluta, Willd.; by A. J. Downing, - - - - - - -	45
V.	On the Economical Uses of some species of Testacea,	53
VI.	Notes on a Tour in France, Italy, and Elba, with a notice of its Mines of Iron; by Prof. F. Hall, - -	74
VII.	Notes on Chemistry, &c.; by Prof. J. W. Bailey,	85
VIII.	A Visit to the Salt Works of Zipaquera, near Bogota, in New Granada; by J. H. Gibbon, M. D. - -	89
IX.	Meteorological Journal, for the year 1836, kept at Marietta, Ohio; by Dr. S. P. Hildreth, - - - -	95
X.	Remarks on some of the Gold Mines, and on parts of the Gold Region of Virginia, founded on personal observations, made in the months of August and September, 1836; by B. Silliman, - - - - - - - -	98
XI.	Notice of some facts connected with the Gold of a portion of North Carolina; by Franklin L. Smith, Esq.	130
XII.	Notice of the Shad and Shad Fisheries of the River Delaware; by Samuel Howell, M. D. - - -	134
XIII.	Formic Acid—remarks upon its utility, together with a correction of Döbereiner's process and views respecting the theory of its formation; by Prof. J. P. Emmet,	140
XIV.	On the Identity of the Torrelite of Thomson with Columbite; by James D. Dana, A. M. - - - -	149
XV.	On the Causes of the Tornado, or Water Spout; by Prof. R. Hare, M. D. - - - - - - - - -	153
XVI.	Description of Edwardsite, a new Mineral; by Prof. Charles Upham Shepard, M. D. - - - - -	162
XVII.	Description of a new Trilobite; by Prof. Jacob Green,	167

MISCELLANIES.—DOMESTIC AND FOREIGN.

Page.

1. Mr. Faraday on the most improved form of the Galvanic Deflagrator, especially as constructed by Dr. Hare, - - 170
2. Fossil footsteps in sandstone and graywacke, - - - 174
3. Observations on the Aurora Borealis of Jan. 25, 1837, - 176
4. Foreign accounts of the Meteoric Shower of Nov. 1836, - 181
5. United States' gold mine, near Fredericksburgh, Va., - 183
6, 7. Culpeper gold mine, Virginia—Geological Reports, - 185
8, 9. Fire bricks—Supposed volcano at sea, - - - 195
10. Visit to Iceland, - - - - - - - - - 196
11, 12. Storms—Galvanism, - - - - - - - - 197
13. Animal electricity, - - - - - - - - 198
14. Fall of fishes from the atmosphere in India, - - - 199
15. Nature of different cements, - - - - - - 200
16. Telegraphs, - - - - - - - - - - 201
17, 18. Scientific Congress at Metz—New York Statistical Society, - - - - - - - - - - 202
19, 20. Officers of the New York Lyceum of Natural History—Transactions of the Maryland Academy of Science and Literature, - - - - - - - - - - 204
21. Proposed new work on American skulls, - - - - 207
22, 23. Maury's treatise on Navigation—Gummere's Astronomy, 208
24. Wiseman's Lectures on the connection between Science and Revealed Religion, - - - - - - - - 209
25, 26, 27. Dr. Buckland's new work—Lyell's Geology, 5th edition—Lindley's Introduction to Botany, - - - - - 210
28, 29. Lindley's Natural System of Botany—Hints on the cultivation of the Mulberry, &c. - - - - - - - 211
30, 31, 32. Johnston's Chemical Tables—Magazine of Zoology and Botany—Thomson's Records of Science, - - 212
33. The Annals of Electricity, Magnetism and Chemistry, &c. 213

Obituary: Dr. Edward Turner, - - - - - - 213
M. Persoon—Mr. Richard Cunningham—Mr. Edward Turner Bennet, - - - - - - - - 215
Dr. William Henry, - - - - - - - 216

East Indian Geology, - - - - - - - - 216

Appendix.

Notice of the Electro-Magnetic Machine of Mr. Thomas Davenport, of Brandon, near Rutland, Vermont.

NUMBER II.

Page.

Art. I. Observations upon certain A[illegible] and Optical Phenomena; by Alexander C. Twining, - - - - 217
II. Geological and Mineralogical Notices; by Prof. Oliver P. Hubbard, M. D. - - - - - - - 230
III. On the Economical Uses of some species of Testacea, 235
IV. Criticisms and suggestions respecting Nomenclature; by Prof. Robert Hare, M. D. Also, a Letter from the celebrated J. J. Berzelius, - - - - 259
V. Description of an Electrical Machine, with a Plate four feet in diameter, so constructed as to be above the Operator: also, of a Battery Discharger employed therewith: and some Observations on the Causes of the Diversity in the Length of the Sparks erroneously distinguished by the terms Positive and Negative; by Prof. R. Hare, M. D. &c. - - - - - - - 272
VI. Of an Improved Barometer Gage Eudiometer; by Prof. R. Hare, M. D. &c. - - - - - - - 280
VII. Engraving and Description of Voltaic Series, combining the advantages of the trough of Cruickshank with those of the Deflagrator; by Prof. R. Hare, M. D. &c. 285
VIII. A Natural System of Botany; or a systematic view of the Organization, Natural Affinities, and Geographical Distribution of the whole Vegetable Kingdom; together with the uses of the most important species in Medicine, the Arts, and rural or domestic economy; by John Lindley, Ph. D. &c. - - - - 292
IX. Electro-Meteorological Observations; by Jas. Swaim, 304
X. Experiments upon the Induction of Metallic Coils; by John B. Zabriskie, M. D. - - - - - 308
XI. Description of the model of an Electro-Magnetic Engine, constructed by John B. Zabriskie, M. D. - - 313
XII. On Zinc Roofing; by Prof. L. D. Gale, - - 315
XIII. On the Common Blowpipe; by Prof. J. W. Bailey, 319
XIV. Notice of the Gold Veins of the United States' Mine near Fredericksburg, Va.; by Lieut. M. F. Maury, U. S. N. 325
XV. Chronometers, - - - - - - - 330
XVI. Chemical Examination of Microlite; by Prof. Charles Upham Shepard, M. D. - - - - - - 338
XVII. Notice of Eremite, a new Mineral Species; by Prof. Charles U. Shepard, M. D. - - - - 341

Page.

XVIII. Description of several New Trilobites; by Prof. JACOB GREEN, M.D. - - - - - - - - 343

XIX. Remarks on the supposed connexion of the Gulf Stream with opposite currents, on the coast of the United States; by WILLIAM C. REDFIELD, - - - - - 349

XX. On the use of the Dynamic Multiplier, with a new accompanying apparatus; by C. G. PAGE, M. D. - - 354

XXI. Description of the Skull of the Guadaloupe Fossil Human Skeleton; by Prof. JAMES MOULTRIE, M.D. With introductory remarks; by C. U. SHEPARD, M. D. 361

MISCELLANIES.—DOMESTIC AND FOREIGN.

1. Annual Report of the Curators of the Boston Society of Natural History, - - - - - - - - 364
2. Crosse's galvanic apparatus, - - - - - - 372
3. Accidental production of animal life, - - - - - 374
4. Fossil remains of the elephant, - - - - - - 377
5. Interlocking of beech trees, - - - - - - 379
6. Rotting of timber in certain situations, - - - 380
7. The odor of wines, due to a peculiar ether, - - - 381
8. Essential oil of potatoes, - - - - - - - 382
9. Memoir on the province of Oman, in Arabia, - - 383
10. Meteorological tables for the year 1836, at St. Louis, - 386
11. Dana's System of Mineralogy, - - - - - - 387
12, 13. Transactions of the Natural History Society of Hartford, Conn.—Meteors at Hingham, Mass. - - - - - 392
14. Auroral appearance, - - - - - - - - 393
15. Meteorite, - - - - - - - - - - 395
16, 17. Aurora Borealis of February 18, 1837—The production of galvanic music, - - - - - - - - 396
18. American edition of Dr. Buckland's late Work on Geology and Mineralogy, considered with reference to Natural Theology, - - - - - - - - - - 397
19. Incidents of Travel in Egypt, Arabia Petræa, and the Holy Land, - - - - - - - - - - 398
20, 21, 22, 23, 24. Earthquake—Edmonson's revolving magnet—Electro-magnetic machine of Davenport & Cook—Geological survey of Connecticut—Asia Minor, - - - - 399
25, 26. Silex—White race of Atlas, - - - - - 400

ERRATA.

Vol. XXXII.

P. 305, l. 4 fr. top, for *bevel* read *level;* l. 3 fr. bot. after *wire,* add—"The number of divisions was then taken where the arms met."

ERRATA.

The reader is requested to correct the following errata in Vol. XXX. of the American Journal of Science. The writer of that article, at the time of its publication was in the Indian country, on Red river, several hundred miles west of the Mississippi, where the proof sheets could not be sent to him; and it is only since his return from that part of the country, that he has seen the article in print. There are several errors in punctuation, but the verbal errors only will be noticed.

W. W. Mather, *Mining Engineer.*

P. 326, l. 3 fr. bot. for *quality*, read *equality*.—P. 328, l. 9 fr. top, for *exhaustible*, read *expansible;* l. 11 fr. top, for *will thrust*, read *will be thrust*.—P. 329, l. 7 fr. top, for *those*, read *that*.

Vol. xxxii.—P. 272, l. 5 fr. top, for 9, read 266.—P. 290, l. 17 fr. top, for *opposite*, read *preceding*.

CORRECTION.

In Prof. Green's notice of Trilobites, in this No. p. 169, for *Asaphus Platypleurus*, read *Trimerus Platypleurus*, this correction being made in consequence of the examination of more specimens from the same locality.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*General Remarks on the Temperature of the Terrestrial Globe and the Planetary Spaces;* by Baron FOURIER.*

Translated from the French, by Mr. EBENEZER BURGESS, of Amherst College.

THE question of terrestrial temperature, one of the most remarkable and difficult in natural philosophy, involves very different elements which require to be considered in a general light. I have thought it would be useful to have condensed in a single essay, all the results of this theory. The analytical details here admitted, are found in works which I have already published. I was specially desirous of presenting to philosophers, in a concise table, a complete view of the phenomena and the mathematical relations which exist between them.

The heat of the earth is derived from three sources, which should first be distinctly mentioned.

1. The earth is heated by the solar rays; the unequal distribution of which causes diversities of climate.

---

* TO PROFESSOR SILLIMAN.

Dear Sir—Although it is several years since they were published in France, I have never met with a translation of any of Baron Fourier's able papers on the temperature of the globe, nor seen in the English language a full view of the important principles which they develop. I have, therefore, requested Mr. Ebenezer Burgess, a tutor in Amherst College, to make a translation from the 27th No. of the *Annales de Chimie et de Physique*, of an article of Fourier, in which he gives a summary of the results to which he has come on the subject, by the use of mathematical analysis. And should your views of the value of this paper correspond with my own, I hope you may find a place for it, even at this late day, in your Journal. With much respect,

Amherst College, July 4th, 1836. EDWARD HITCHCOCK.

2. It partakes of the common temperature of the planetary spaces; being exposed to the radiations from the innumerable stars which surround the solar system.

3. The earth preserves in its interior a part of that primitive heat which it had at the time of the first formation of the planets.

We shall separately examine each of these three causes, and the phenomena which they produce. We will show, as clearly as we are able in the present state of the science, the principal features of these phenomena. For the purpose of giving a general idea of this great question, and showing at a glance the results of our researches, we present them in the following summary, which is in some measure a synoptic table of the contents of this article, and of several which have preceded it.

The solar system is situated in a region of the universe, every point of which has a common and constant temperature, determined by the rays of light and heat which proceed from the surrounding stars. This low temperature of the planetary space, is a little below that of the polar regions of the earth. The earth would have only the same temperature with the heavens, were it not for two causes which are concurring to heat it. One is the internal heat which it possessed at its formation, a part of which only is dissipated through the surface; the other is the continued action of the solar rays, which penetrate the whole mass, and produce at the surface, the diversities of climate.

The primitive heat of the globe has no longer any sensible effect upon the surface: but it may be very great as we approach the center. The temperature of the surface does not exceed by the thirtieth of a centesimal degree, ($\frac{1}{15}$° Fahrenheit,) the lowest state to which it can ever be reduced. At first it diminished very rapidly: but at present with the greatest slowness.

The observations heretofore collected seem to show that the temperature of different points of the same vertical line, is proportional to the depth, and that this increase of temperature, as we advance towards the center, is about one degree for every thirty or forty meters. Such a result supposes a very high internal temperature. It cannot proceed from the action of the sun's rays; and it is naturally explained by the heat which belonged to the earth at its formation.

This increase of temperature, of about one degree for thirty-two meters will not always remain the same. It gradually diminishes; but many ages must elapse before it can be reduced to half its present value.

If other causes hitherto unknown, can explain the same facts, and if there exist other sources of terrestrial heat, either general or accidental, they will be discovered by comparing the results of this theory with those of observation.

The rays of heat which are continually proceeding from the sun to the earth, produce upon its surface two very distinct effects: one is periodical, and reaches no farther than the exterior crust. The other is constant. It is observed at great depths, say thirty meters, from the surface. The temperature of these places undergoes no sensible change in the course of the year; it is fixed. But it is very different in different climates; it results from the continual action of the solar rays, and from the unequal exposure of different parts of the surface between the equator and the poles. We can determine the time which must pass before the effect of the sun's rays could produce that difference in climate which now exists. All these results agree with those of the dynamic theories which have proved to us the stability of the axis of the earth.

The periodical effects of the solar heat, arise from the diurnal or annual variations. This order of facts is explained exactly, and in all its details, by the theory. The comparison of the results with the observations will serve to measure the conducting power of those substances of which the crust of the globe is composed.

The pressure of the atmosphere and bodies of water, has the general effect to render the distribution of heat more uniform. In the ocean and in the lakes, the coldest particles, or rather those whose density is the greatest, are continually tending downwards, and the motion of heat depending on this cause is much more rapid than that which takes place in solid masses in consequence of their connecting power. The mathematical examination of this effect would require exact and numerous observations. These would enable us to understand how this internal motion prevents the internal heat of the globe from becoming sensible in deep waters.

Liquids are very poor conductors of heat; but they have, like aeriform media, the property of carrying it rapidly in certain directions. This is the same property which, combining with the centrifugal force, displaces and mingles all parts of the atmosphere as well as the ocean, and maintains in them regular and immense currents.

The interposition of the air very much modifies the effects of the heat upon the surface of the globe. The solar rays traversing the atmospheric strata which are condensed by their own weight, heat them very unequally: those which are rarest are likewise coldest, because they extinguish and absorb a smaller part of the rays. The heat of the sun, coming in the form of light, possesses the property of penetrating transparent solids or liquids, and loses this property entirely, when by communication with terrestrial bodies, it is turned into heat radiating without light.

This distinction of luminous and non-luminous heat, explains the elevation of temperature caused by transparent bodies. The mass of waters which cover a great part of the globe, and the ice of the polar regions, oppose a less obstacle to the admission of luminous heat, than to the heat without light, which returns in a contrary direction to open space. The pressure of the atmosphere produces an effect of the same kind: but an effect, which, in the present state of the theory, and from want of observations compared with each other, cannot be exactly defined. Whatever it may be, we cannot doubt that the effect which should be attributed to the impression of the solar rays upon a solid body of very large dimensions, by far surpasses that which would be observed in exposing a common thermometer to the same rays.

The radiation of the most elevated strata of the atmosphere, the cold of which is very intense and almost constant, has an influence upon all the meteorological facts of our observation; it can be rendered more sensible by reflexion from the surface with concave mirrors. The presence of the clouds which intercept these rays, mitigates the cold of the nights.

We see that the surface of the terrestrial globe is placed between a solid mass, the central part of which may surpass that of matter heated to whiteness, and an immense girdle, whose temperature is below that requisite for the congelation of mercury.

All the preceding results can be applied to other planetary bodies. They can be considered as placed in a medium whose constant and common temperature is little below that of the terrestrial poles. This same temperature of the heavens is that of the surface of the most distant planets; for the impression of the rays of the sun, even when augmented by the disposition of the superficies, would be too feeble to occasion sensible effects; and we know by the condition of the terrestrial globe, that, in the planets whose formation cannot be less ancient, there exists upon the surface no longer any elevation of temperature to be attributed to internal heat.

It is equally probable, that in respect to most of the planets, the temperature of the poles is little above that of the surrounding space, with respect to the temperature which each of these bodies owes to the sun, it is not known; because it may depend on the pressure of an atmosphere and the condition of the surface. We can only approximate to the truth in assigning the mean temperature which the earth would have acquired situated in the place of the planet.

After this exposition, we shall examine successively, the different parts of this question. We would first make a remark which has a relation to all these parts, because it is founded upon the nature of differential equations of the motion of heat. It is this: the effects of each of the three causes we have mentioned, may be calculated separately, as if it had no connection with the others. It is sufficient afterwards to unite these partial effects: *ils se superposent librement comme les dernieres oscillations des corps.*

We shall describe in the first place the principal results of the prolonged action of the solar rays upon the terrestrial globe.

If a thermometer is placed at a considerable depth below the surface of the solid earth, forty meters for example, the instrument indicates a fixed temperature. This fact is observed in every part of the globe. This temperature of deep places is always the same in the same place; but it is not the same in different climates. It generally decreases as we advance towards the poles.

If we observe the temperature of points much nearer the surface of the earth, for example, at the depth of one, five, or ten meters, we see very different effects. The temperature varies during a single day or year. But we can suppose the crust or envelop in which these variations take place, to be removed, and consider the fixed temperatures of the points of the new superficies of the globe.

We can conceive that the state of the mass has varied continually in proportion to the heat received from the origin of heat itself. This variable state of internal temperature has changed by degrees, and has approached nearer and nearer to a final state, which is subject to no change. Then each point of the solid sphere has acquired, and preserves, a temperature, a fixed temperature, which depends only on the situation of the point itself.

The final state of the mass, the heat of which has penetrated all its parts, can very justly be compared to that of a vessel which receives by openings at the top, liquid from some constant source, and permits exactly an equal quantity to escape by orifices.

Thus the solar heat has accumulated in the interior of the globe and is there continually renewed. It penetrates the parts of the surface near the equator, and is dissipated through the polar regions. The first question of this kind which has been submitted to the calculus, is found in a memoir which I read to the French Institute, at the close of the year 1807, Art. 115, page 167. This article is deposited in the archives. I then took up this first question to exhibit a remarkable example of the application of the new theory exposed in the memoir; and to show how the analysis points out the tract followed by the solar heat in the interior of the earth.

If now we replace this exterior envelop of the earth, whose points are not sufficiently deep to have a fixed temperature, we remark an order of facts more compound, the complete expression of which is given by our analysis. At a moderate depth, as three or four meters, the temperature observed does not vary during each day, but the change is very perceptible in the course of a year; it varies and and falls alternately. The extent of these variations, that is, the difference between the *maximum* and *minimum* of temperature, is not the same at all depths; it is inversely as the distance from the surface. The different points of the same vertical line do not arrive at the same time at the extreme temperatures. The extent of the variations, the times of the year, which correspond to the greatest, to the mean, or to the least temperatures, change with the position of the point in the vertical line. There are the same quantities of heat which fall and rise alternately; all these values have a fixed relation between themselves, which are indicated by experiments and expressed distinctly by the analysis. The results observed are in accordance with those furnished by the theory; no phenomenon is more completely explained. The mean annual temperature of of any point whatever in the vertical line, that is, the mean value of all those which might be observed in the course of a year, at this point, is independent of the depth. It is the same for all points of the vertical, and consequently that which would be observed immediately below the surface; it is the fixed temperature which exists at great depths.

It is evident that in the enunciation of this proposition, we make no account of the internal heat of the globe, and those accessory causes which would modify this result in a particular place. Our principal object is to ascertain general phenomena. We have before remarked that the different effects can be separately considered.

We ought likewise to observe respecting all the numerical values mentioned in this memoir, that they are presented here only as examples of the calculus. The meteorological observations proper for furnishing the necessary data, those which would show the capacity for heat and the permeability of the substances which compose the globe, are too uncertain and too limited, to enable us, by the calculus to deduce accurate results. But we mention these numbers to show, how formulas ought to be applied: and however much they may differ from true results, these values are much more suitable for giving a correct idea of the phenomena, than general expressions without their numerical application.

In those parts of the crust nearest the surface, the thermometer rises and falls during each day. These diurnal variations cease to be sensible at the depth of two or three meters. Below this we can perceive only annual variations, and these again become insensible at a still greater depth.

If the rapidity of the motion of the earth around its axis were to be infinitely increased, and the same were supposed to take place respecting its motion round the sun, the diurnal and annual variations would no longer be observed, the points of the surface would have acquired and would preserve the fixed temperatures of places at a great depth. In general the depth which we must reach in order that the variations may become insensible, has a very simple ratio to the duration of the period which reproduces the same effects at the surface. This depth is exactly proportional to the square root of the period. It is for this reason that the diurnal variations penetrate only to one nineteenth of the depth at which the annual variations are observed. The question of a periodical motion of the solar heat was examined for the first time, and resolved in a separate paper, submitted to the French Institute in October, 1809. I again brought forward this solution in a paper submitted at the close of 1811, and printed in the collection of our memoirs.

The same theory furnishes the means of measuring the quantity of heat which in the course of a year determines the succession of the seasons.

The design of this example of the application of formulas is to show that there exists a necessary relation between the laws of periodical variation and the whole quantity of heat which effects this variation: so that this law being known by observations made in a given climate, we can determine the quantity of heat which penetrates the ea h and returns into the air. Considering, therefore, a law similar this, which is established of itself in the interior of the globe, I ha obtained the following results.

In one nth of a year after the temperature at the surface is raised to i mean value, the earth begins to be heated; the rays of the sun p etrate it during six months. Then the heat of the earth takes an posite direction; it comes out and is dissipated in the air and ext nal space. Now the quantity of heat which undergoes these va tions in the course of a year is expressed by the calculus. If the c t of the earth was formed of a metallic substance of forged iron, (t substance which I have chosen for an example, after having m ured the specific coefficients,) the heat which produces the su ssion of the seasons, would be for the climate of Paris, and for a s re meter of surface, equivalent to what would melt a cylindrical lumn of ice, having for its base this square meter, and a heig' f about three meters and one tenth. Although the value of oefficients for substances of which the globe is composed, has as yet been measured, we can easily see that they would giv esult much less than we have just mentioned. It is proportio to the square root of the product of the capacity for heat, cc ered in relation to volume and the permeability.

e will now consider the second cause of terrestrial heat, which, e think, resides in the planetary spaces. The temperature of space exactly defined, is that which a thermometer would indi-, supposing the instrument placed in any part of the space occu-l by the solar system, and the bodies which compose this system ihilated.

We shall give a detail of the principal facts from which we have scertained the existence of this heat, peculiar to the planetary paces, which is independent of the presence of the sun, and of the original heat which the earth has preserved. To obtain a knowledge of this singular phenomenon, it is necessary to ascertain what would be the thermometrical state of the terrestrial mass, if it received only the heat from the sun. To facilitate this enquiry we may at first leave the atmosphere out of the account. Now if there existed no cause sufficient to give the planetary spaces a common and constant temperature, that is, if the earth and all the bodies of the solar system, were placed in space deprived of all heat, the phenomena observed would be altogether contrary to what we now witness. The polar regions would be subject to an intense cold and the decrease of temperature from the equator to the poles would be incomparably more rapid and extended.

In this hypothesis of the absolute cold of space, if it is possible to conceive of it, all the effects of heat which we observe at the surface of the earth, should be attributed to the presence of the sun. The least variations in the distance of that body from the earth, would occasion very considerable changes of temperature. The interruption of day and night, would produce effects sudden and totally different from what we observe.

The surfaces of bodies, would be exposed all at once, at the commencement of night, to a cold of infinite intensity. Animals and vegetables could not resist the sudden and powerful change which would be produced at the rising of the sun.

The primitive heat preserved in the interior of the earth could not increase the external temperature of space, and would prevent none of the effects which we have just described; for we know with certainty, by theory and observation, that the effect of this central heat has long since become insensible at the surface, although it may be very great at a moderate depth. We conclude from these observations, and chiefly from the mathematical examination of the subject, that there exists a physical cause always present which modifies the temperature at the surface of the earth, and gives this planet a fundamental heat, which is both independent of the action of the sun and that internal heat preserved in its own center. This fixed temperature, which the earth receives from space, differs but little from that which is measured at the poles. It is necessarily less than that of the coldest regions; but in this comparison we ought to admit only accurate observations, and should not consider the accidental effects of a very intense cold which may be caused by evaporation, by violent winds, and extraordinary dilatation of air.

After ascertaining the existence of this fundamental temperature of space, without which the effects of heat observed upon the surface of our globe could not be explained, we proceed to remark, that the origin of this phenomenon, thus to call it, is evident. It is to be attributed to the radiation from all the bodies in the universe, whose light and heat can reach us; the stars visible to the naked eye, the innumerable multitude of telescopic stars or opaque bodies, which fill the universe, the atmospheres which surround these immense bodies, the rare matter disseminated through every part of space, concur in forming rays which penetrate every part of the planetary regions. We cannot conceive of the existence of such a system of luminous and heated bodies without admitting that any point of space whatever which contains these bodies acquires a fixed temperature.

The immense number of bodies compensates for the inequalities in their temperatures, and renders radiation sensible and uniform.

This temperature of space is not the same in different regions of the universe; but it does not vary in the regions in which are situated the planetary bodies; because the dimensions of this space are incomparably smaller than those distances which separate it from the radiating bodies; for example, in all points of the orbit of the earth this planet finds the same temperature.

It is the same with other planets of our system: they all equally participate in the common temperature, which is more or less augmented for each one of them, by the rays of the sun, according to the distance of the planet from that body. Respecting the inquiry what must be the temperature of each of the planets, the principles which must settle it, furnished by an exact theory, are as follows. The intensity and distribution of heat on the surface of these bodies results from the distance of the sun, the inclination of the axes of rotation to the orbit, and the state of the surface. It is very different even in its mean value, from what would be indicated by a thermometer insulated in the place of the planet, for the solid state, the very great dimensions, and doubtless the presence of an atmosphere and the nature of the surface, determine the mean value.

The original heat which has been preserved in the interior, has long since ceased to have a very sensible effect upon the surface. For the present state of the crust of the earth shows us that the primitive heat of the surface is almost entirely dissipated. From the constitution of the solar system it is very probable that the temperature of the poles of each planet, or at least of the greatest part of them, is little less than that of space. This polar temperature is the same for all these bodies, although their distances from the sun may be unequal.

We can determine with some degree of precision, the temperature which the earth would have acquired if situated in the place of each of the planets; but the temperature of the planets themselves, cannot be ascertained; for in order to that we must know the state of the surface and the atmosphere. However, this uncertainty no longer exists as to the bodies which are placed at the extremities of the solar system like the planet Uranus. The impression of the solar rays upon this planet is evidently insensible. The temperature of the surface differs therefore, very little from that of planetary spaces, or from that which is observed at the poles of our globe. We have made known this last result in a discourse recently delivered before the Academy. It is evident we can apply it only to the most distant planets. We know of no means of assigning with any precision the mean temperature of the other planetary bodies. The motion of the air and waters, the extent of the seas, the elevation and form of the surface, the effects of human industry and all the accidental changes of the earth's surface, modify the temperatures of each climate. The character of phenomena attributable to general causes exists: but the thermometrical effects observed at the surface are different from what they would be without the influence of accessory causes.

The motion of the waters and of the air, tends to modify the effects of heat and cold.

It renders their distribution more uniform, but it would be impossible for the atmosphere to supply the place of that universal cause which supports the common temperature of the planetary spaces; and if this cause did not exist, we should observe, notwithstanding the atmosphere and seas, an enormous difference between the temperatures of the equatorial and polar regions.

It is difficult to know how far the atmosphere influences the mean temperature of the globe; and in this examination we are no longer guided by a regular mathematical theory. It is to the celebrated traveller, M. de Saussure, that we are indebted for a capital experiment, which appears to throw some light on this question.

The experiment consists in exposing to the rays of the sun, a vessel covered with one or more plates of glass, very transparent, and placed at some distance one above the other. The interior of the vessel is furnished with a thick covering of black cork, proper for receiving and preserving heat. The heated air is contained in all parts, both in the interior of the vessel and in the spaces between the plates. Thermometers placed in the vessel itself and in the intervals above, mark the degree of heat in each space. This instrument was placed in the sun about noon, and the thermometer in the vessel was seen to rise to 70°, 80°, 100°, 110°, (Reaumur,) and upwards. The thermometers placed in the intervals between the glass plates indicated much lower degrees of heat, and the heat decreased from the bottom of the vessel to the highest interval.

The effect of solar heat upon air confined within transparent coverings, has long since been observed. The object of the apparatus we have just described, is to carry the acquired heat to its *maximum;* and especially to compare the effect of the solar ray upon very high mountains, with what is observed in plains below. This experiment is chiefly worthy of remark on account of the just and extensive inferences drawn from it by the inventor. It has been repeated several times at Paris and Edinburgh, and with analogous results.

The theory of the instrument is easily understood. It is sufficient to remark, 1st, that the acquired heat is concentrated, because it is not dissipated immediately by renewing the air; 2d, that the heat of the sun, has properties different from those of heat without light. The rays of that body are transmitted in considerable quantity through the glass plates into all the intervals, even to the bottom of the vessel. They heat the air and the partitions which contain it. Their heat thus communicated ceases to be luminous, and preserves only the properties of non-luminous radiating heat. In this state it cannot pass through the plates of glass covering the vessel.

It is accumulated more and more in the interval which is surrounded by substances of small conducting power, and the temperature rises till the heat flowing in, shall exactly equal that which is dissipated. This explanation might be verified, and the results made more apparent, by varying the conditions and employing colored or blackened glasses, and exhausting the air from the intervals which contain the thermometers. When this effect is examined by the calculus, results are obtained in exact accordance with those of observation. It is necessary to consider attentively this order of facts, and the results of the calculus when we would ascertain the influence of the atmosphere and waters upon the thermometrical state of our globe.

In short, if all the strata of air of which the atmosphere is formed, preserved their density with their transparency, and lost only the mobility which is peculiar to them, this mass of air, thus become solid, on being exposed to the rays of the sun, would produce an effect the same in kind with that we have just described. The heat, coming in the state of light to the solid earth, would lose all at once, and almost entirely, its power of passing through transparent solids: it would accumulate in the lower strata of the atmosphere, which would thus acquire very high temperatures. We should observe at the same time a diminution of the degree of acquired heat, as we go from the surface of the earth.

The mobility of the air, which is rapidly displaced in every direction, and which rises when heated, and the radiation of non-luminous heat into the air, diminish the intensity of the effects which would take place in a transparent and solid atmosphere, but do not entirely change their character. The decrease of heat in the higher regions of the air does not cease, and the temperature can be augmented by the interposition of the atmosphere, because heat in the state of light finds less resistance in penetrating the air, than in repassing into the air when converted into non-luminous heat. We shall now consider that peculiar heat which our globe had at the time of the formation of the planets, and which continues to be dissipated at the surface under the influence of the low temperature of the planetary space.

The opinion of an internal fire as a perpetual cause of many remarkable phenomena, has been renewed in every age of philosophy. The end we have in view at this time, and which the latest progress of mathematical science enables us to reach, is to ascertain exactly by what laws a solid sphere heated by a long immersion in a medium, would discharge that primitive heat if it were transported into a space of a constant temperature inferior to that of the first medium. The design of the experiment is, to ascertain if the present temperature of the surface of the globe can yet undergo any sensible changes. The form of the terrestrial spheroid, the regular order of the lower strata, made manifest by experiments with the pendulum, their density increasing with the depth, and divers other considerations, concur in proving that a heat of very great intensity has at some previous period penetrated every part of the globe. This heat is dissipated by radiation into surrounding space, which has a temperature much below that of the congelation of water. Now the mathematical expression for the law of cooling shows that the primitive heat contained in a spherical mass of as great dimensions as the earth, diminishes much more rapidly at the surface than in parts situated at a great depth. These latter preserve almost all their heat for an immense period of time. There can be no doubt respecting the truth of these results, because we have calculated these times for metallic substances, which have a greater conducting power than those of which the globe is composed.

But it is evident that theory alone can only teach us the laws to which phenomena are subject. It remains now to inquire whether in penetrating the earth, we find any indications of a central heat.

We must ascertain, for example, whether the temperature increases with the depth as we go below those points whose diurnal and annual variations have ceased to be sensible. Now all observations collected and examined by the most learned philosophers of our day, show us that such an increase actually exists. It has been estimated at about one degree for thirty or forty metres. The experiments with which we have lately entertained the Academy, relating to the heat of springs, confirm the results of preceding observations.

The object of the inquiry we propose, is to discover the certain consequences of this single fact, admitting it to be given by direct observation; and to prove that it determines, first, the situation of the source of heat, and, secondly, the excess of temperature which still exists at the surface.

It is easy to conclude, (and the same result is obtained from an exact analysis,) that the increase of temperature as we go towards the centre cannot be produced by a prolonged action of the sun's rays. The heat proceeding from that body is accumulated in the interior of the earth; but the progress has almost entirely ceased, and if the accumulation was still continued, we should observe that increase in a direction precisely contrary to what we have mentioned. The cause which gives to deep strata a higher temperature, is, therefore, an internal source of constant or variable heat, situated below where man has been able to penetrate. This cause raises the temperature of the surface above what it would have been from the simple action of the sun's rays. But this excess of temperature of the surface has become almost insensible. Of this we are assured, because there exists a mathematical ratio between the value of increase by metre and the quantity, by which the temperature of the surface still exceeds that which would be found, if the internal cause of which we are speaking did not exist. To measure the increase by unity of depth, is the same thing as to measure the excess of temperature at the surface.

In a globe of iron the increase of a thirtieth of a degree per metre, would only give a fourth degree of actual elevation of temperature at the surface. This elevation is in direct ratio to the conducting power of the substance of which the crust is formed, all other conditions remaining the same. Thus the excess of temperature, which the terrestrial surface has at present, in consequence of this internal source, is very small; it is probably below the thirtieth of a centesimal degree, ($\frac{1}{15}°$ Fahrenheit.) We ought to remark that this last result can be applied to all suppositions which can be made upon the cause, whether it be regarded as local or universal, constant or variable.

When we examine all the observations relative to the figure of the earth attentively, and according to principles of dynamics, we cannot doubt that the earth received at its origin a very high temperature. On the other hand, thermometrical observations show that the actual distribution of heat in the crust of the earth, is precisely what it would be if the earth had been formed in a medium of very high temperature, and had afterwards been left gradually to cool. It is important to notice the agreement of these two kinds of observations.

The question of terrestrial temperature has always appeared to us as one of the most important inquiries relating to cosmogony; and we have had this principally in view in establishing the mathematical theory of heat. From the commencement of our researches we have been desirous of ascertaining the laws of internal temperature in a solid sphere, heated at first by immersion in a medium, and afterwards left to cool in a medium of lower temperature. The memoir of 1807, before cited, contains a complete solution of that question, which was never before examined.

We have therefore determined the variable state of a globe, of a substance whose specific qualities we know, by experiment, and which after being immersed for some time in a heated medium, is transported to a colder space. We have considered likewise the variable state of a sphere which, having been plunged successively and for some time in two or more media of different temperatures, should undergo a final cooling in a medium of constant temperature.

After having noticed the general consequences of the solution of that question, we have examined particularly the case in which the primitive temperature acquired in a heated medium, might become common to the whole mass. And supposing the solid sphere to be of very great dimensions, we have endeavored to ascertain the law of progressive diminution of temperature in those strata nearest the surface. If we apply the results of this analysis to our globe, to ascertain what would be the successive effects of a primitive formation like that we have just supposed: we find that the increase of a thirtieth of a degree per metre, considered as the resultant of central heat, has in former periods been much greater, and that this increase is now almost a constant quantity, since more than thirty thousand years must elapse before it would be reduced to half its present value.

Respecting the excess of temperature at the surface, it varies according to the same law. The quantity by which it diminishes each century, is equal to the present value divided by double the number of centuries which have elapsed since the cooling process commenced: and since the limit of this number is given by historical monuments, we conclude that, from the Greek school at Alexandria, till the present time, the temperature of the surface has not diminished, on this account, the three hundredth part of a degree, ($\frac{1}{600}$° Fahrenheit.) Here again we find that stability which the great phenomena of the universe every where present. This stability, furthermore, is a necessary result, and independent of the primitive state, since the present excess of temperature is extremely small, and will diminish for an infinite length of time.

The effect of the primitive heat which our globe still preserves, has become nearly insensible at the surface of the crust; but it becomes more sensible at accessible depths, since the temperature augments with the distance from the surface. This augmentation, considered by unity of measure, would not have the same value for depths very much greater. It diminishes with this depth; but the same theory shows that the excess of temperature, which is almost nothing at the surface, can become enormous at a distance of some thousands of metres, so that the heat of the intermediate strata would exceed by far that of substances heated to whiteness.

The course of centuries will produce great changes in these internal temperatures; but at the surface these changes are at an end, and the continual loss of internal heat cannot hereafter occasion any cooling of climate.

It is important to remark, that the mean temperature of any place may undergo, from other accessory causes, variations more sensible by far than those which are produced by the continued cooling of the globe.

The establishment and progress of human society, and the action of natural powers, may, in extensive regions, produce remarkable changes in the state of the surface, the distribution of the waters, and the great movements of the air. Such effects, in the course of some centuries, must produce variations in the mean temperature for such places; for the analytical expressions contain coefficients which are related to the state of the surface, and have a great influence on the temperature.

Although the effect of internal heat may be no longer sensible at the surface, the sum total of this heat which escapes in a given time, as in a year or a century, is measurable, and has been ascertained. That which escapes in a century through a square metre, and is dissipated in the celestial space, would melt a column of ice, of which the base should be a square metre, and height three metres.

This result is derived from a fundamental proposition, which can be applied to all questions relating to the motions of heat, and especially to that of terrestrial temperature. I allude to the differential equation, which expresses for each moment the state of surface. This equation, the truth of which is plain, and easily demonstrated, establishes a simple relation between the temperature of an element of the surface and the normal motion of heat. What renders this result of theory very important, and more valuable than any other for throwing light upon the questions which form the subject of this article, is, that it exists independent of the form and dimensions of bodies, and of the nature of the substances, whether homogeneous or not, of which the internal mass may be composed. The results of this equation are absolute: they are the same, whatever may have been the material constitution or original state of the globe.

We have published in the "*Annales de Chimie et de Physique,*" the abstract of a memoir, which has not yet been printed, and the object of which is to apply to the terrestrial globe the analyses of the motions of heat in a sphere or plane solid, of great dimensions. In that extract the principal formulas were exhibited, particularly those which express the variable state of a solid uniformly heated at a determinate and very great depth, or in its whole depth. If the original temperature, instead of being the same to a very great depth, results from successive immersions in several media, the consequences are not less simple or remarkable. But this case, and several others which we have considered, are comprised in the general expressions which have been mentioned.

After having explained separately the principles of the inquiry respecting the temperature of the earth, in order to form a correct idea of these phenomena united, we ought to give, in a general statement, all the effects we have just described.

The earth receives the rays of the sun, which penetrate its mass, and are converted into non-luminous heat: it likewise possesses an internal heat with which it was created, and which is continually dissipated at the surface: and lastly, the earth receives rays of light and heat from innumerable stars, in the midst of which is placed the solar system. These are three general causes which determine the temperature of the earth. The third, that is, the influence of the stars, is equivalent to the presence of an immense hollow sphere, with the earth in the center, the constant temperature of which should be a little below what would be observed in the polar regions.

We might, doubtless, suppose radiating heat to possess properties hitherto unknown, which might, in some way, take the place of this fundamental temperature, which we attribute to space. But in the present state of physical science, all known facts are naturally explained without having recourse to other properties than those derived from actual observation. It is sufficient to represent the planetary bodies as occupying a space, the temperature of which is constant. We have endeavored, therefore, to ascertain what this temperature ought to be, in order that the effects on the thermometer should be what we now observe. Now they would be entirely different if we were to admit an absolute cold in space: but if we progressively increase the common temperature of the girdle or hollow sphere which encloses this space, we should see effects produced similar to what we now witness. We can, therefore, affirm, that the actual phenomena are such as would be produced if radiation from the stars was giving this temperature to all points of the planetary space. The primitive internal heat which is not yet dissipated, produces now but a very slight effect upon the surface of the earth: it manifests itself by an increase of temperature at great depths. At still greater distances from the surface it may exceed the highest temperatures which have ever been measured.

The effect of the solar rays is periodical in the superficial strata of the terrestrial crust. It is fixed in all points of great depths. This fixed temperature of the internal parts is not the same for all points. It depends principally upon the latitude of the place.

The solar heat has accumulated in the interior of the globe, the state of which has become unchangeable. That which penetrates in the equatorial regions is exactly balanced by that which escapes at the parts around the poles. Thus the earth gives out to celestial space all the heat which it receives from the sun, and adds a part of what is peculiar to itself.

All the terrestrial effects of solar heat are modified by the interposition of the atmosphere and the presence of water. The great motions of these fluids render the distribution more uniform. The transparency of the waters appears to concur with that of the air in augmenting the degree of heat already acquired, because luminous heat flowing in, penetrates, with little difficulty, the interior of the mass, and non-luminous heat has more difficulty in finding its way out in a contrary direction.

The succession of the seasons is maintained by an immense quantity of solar heat, which oscillates in the crust of the earth, passing below the surface during one half of the year, and returning into the air in the other half. Nothing can contribute more to throw light upon this part of the inquiry than the experiments, the object of which is, to measure with precision the effects of the solar rays upon the earth's surface. For this reason, we heard with the greatest interest the reading of the memoir presented by Prof. Pouillet; and if in the course of this article we have not mentioned his experimental researches, it is simply from the wish not to anticipate the report which will soon be made.

I have united in this article all the principal elements of the analysis of terrestrial temperature. It is made up from the results of my researches long since given to the public. When I began the investigation of such questions there existed no mathematical theory of heat, and we might well have doubted that such a theory could be possible. Those memoirs and treatises in which I have established this theory, and which contain the exact solution of the fundamental questions, have been submitted and publicly read, or printed and analyzed in the "*Recueils Scientifiques*," of the last few years. The object of this last article is to invite attention to one of the most important questions of natural philosophy, and to present general views and results. It would be impossible to resolve all doubts connected with a subject so extensive; which comprises, besides the results of a new and different analysis, physical considerations very varied in their natures. Exact observations will hereafter be multiplied. The laws on which depends the motion of heat in liquids and air, will be studied. Perhaps other properties of radiating heat will be discovered, or causes which modify the temperatures of the globe. But all the principal laws of the motion of heat are known. This theory, which rests upon immutable foundations, constitutes a new branch of mathematical science. It is composed, at present, of differential equations of the motion of heat in solids and liquids, and of the integrals of these first equations, and theorems relative to the equilibrium of radiating heat.

These theories will be hereafter much farther extended, and nothing will contribute more to bring them to perfection than numerous series of exact experiments; for mathematical analysis can deduce from general and simple phenomena, the expressions of the laws of nature; but the application of these laws to very complicated effects, requires a long course of accurate observations.

Art. II.—*Account of an Excursion to Mount Katahdin, in Maine;* by J. W. Bailey, Acting Professor of Chemistry, &c. U. S. Military Academy, West Point.

TO PROFESSOR SILLIMAN.

Sir—During a short visit which I made this summer to Waterville, in Maine, my curiosity was excited by the accounts I read and heard concerning Mount Katahdin, the highest mountain in the State. Its elevation and isolated position, together with the traditionary legends of the Penobscot Indians, that Katahdin is the residence of evil spirits, have given to this mountain considerable local celebrity. It has, however, been visited by few white men, and of their observations no accurate accounts have been published. Not being aware of the proposed geological survey of the State, (which, since my return, I learn has been assigned to able hands,) and in hopes that by visiting this mountain some interesting geological and botanical observations might be made, I proposed to Prof. Keely of Waterville College an excursion, on which Prof. Barnes of the same institution promised to accompany us.

In this communication, the object of which is to give a sketch of our journey and observations, I have purposely entered into some details, which may appear too trivial for admission into a scientific journal, but I believe these will be useful, by giving to any persons who may wish to visit Katahdin some idea of the manner of life they may expect to lead, the preparations to be made, and the route to be pursued.

Having procured a light wagon, Mr. Keely and myself proceeded on Saturday, the 6th of August, for Bangor. Our route lay through Clinton, Dixmont and Hampden. The rock passed over this day was argillite or graywacke slate, divided into very thin, nearly vertical laminæ, slightly dipping to the southeast. The direction or bearing of the edges of the laminæ is almost invariably about northeast and southwest, subject however in some places to most singular contortions, the general direction being still preserved. This argillite is well exposed in the bed of the Kennebeck at Waterville, and at the beautiful falls in West Waterville. This day we saw it in the bed of the Sebasticook at Clinton, and observed it often on the road to Dixmont, where it rises to a considerable elevation, and forms part of the dividing ridge between the Kennebeck and Penobscot valleys. Over the slate is generally spread a deposit of bluish gray clay, much used in making bricks, and upon the clay a diluvial deposit of boulders, principally of granite. We stopped for the night at a tavern near Hampden, and the next morning rode through Bangor and Stillwater, to Orono or Old Town. In the Penobscot at Bangor, and all the way to Old Town, the slate was seen preserving all its usual characters. At Orono it forms both banks of the Penobscot, and continues eastward, but how far I had no means of determining.

At Old Town, it being Sunday, we remained through the day and until noon on Monday, awaiting the arrival of Prof. Barnes, who had promised to join us at this place. During our stay we visited the Indian island belonging to the miserable remnant of the Penobscot tribe. The greater part of the Indians were absent on a fishing expedition to the sea-coast. They have here a neat chapel, and several frame houses, besides huts. A Roman Catholic priest resides with them. We asked one of the Indians how he liked his priest; he answered, "Oh, middling!" On Monday at noon, as Mr. Barnes had not arrived, we went on without him, and proceeded on the left bank of the river, by a fine road, to the tavern at Piscataquis, where we found as good accommodations as could be desired. We were particularly struck during our ride with the great quantity of *Epilobium spicatum*, which is generally known in this state by the name of *Fire weed*, from the abundance in which it springs up in fields recently burned over. Near Old Town I observed beds of *Calla palustris* in flower. From a short distance above Old Town, we did not observe along the road any argillite *in situ*, although its occasional appearance, in loose masses, indicated its close proximity. At the Piscataquis Falls, it again appears *in situ*.

Tuesday Morning.—We set out early for Matawamkeag Point, and proceeded as far as Lincoln on the good state road; breakfasted at Lincoln, and then proceeded on the military road leading by Matawamkeag Point to Holton, to which place a mail stage runs three times a week. Along the road we found fine specimens of *Orchis blephariglottis*, and near Matawamkeag Point passed over argillite well exposed.

At "the Point" there is a tolerable tavern, where we left our horse and wagon, trunks, &c. and prepared for our march into the woods. As we had been informed that there was a settlement at Grand Falls, about twenty three miles from the Point, where we would be able to procure blankets, provisions, boat and guides, we took with us only a few indispensable articles of dress, and a book to preserve botanical specimens. Thus lightly laden, we commenced the most arduous part of our journey. Crossing the Matawamkeag by the fine bridge built at the expense of the United States, and bidding farewell to civilization, we plunged into the woods by a blind path, (if path it might be called,) which was scarcely passable, although we were on foot, it was so obstructed by fallen trees, tangled roots, bushes and mud holes. At first it led us to the bank of the Penobscot; along the left bank it then continues, generally at a short distance from the river. As we had no guides, we were often much at a loss what direction to take, as the true path is often crossed by "logging paths," made during winter by the "loggers," for the purpose of hauling their lumber to the river. Whenever we lost our way, we made for the river, and proceeded awhile along its banks, until progress became too difficult, when we again turned into the woods, and generally succeeded in finding our path at a short distance from shore.

The forest through which we passed consisted generally of a growth of white pine, *Pinus strobus;* hemlock, *P. Canadensis;* larch, *P. pendula*, Ait.; spruce, *P. nigra* and *P. alba;* cedar or arbor vitæ, *Thuja occidentalis;* beach, *Tagus ferruginea;* &c. with an under growth of moose-wood, *Acer striatum*, and hobble-bush, *Viburnum lantanoides.* Among the herbaceous plants, we found fine specimens of *Orchis orbiculata*, Pursh, *Orchis grandiflora*, *Goodyera pubescens*, *Neottia cernua*, *Aralia hispida*, *A. racemosa*, *Dalibarda repens*, *Monotropa uniflora*, *Pyrola secunda*, and *P. umbellata.*

Among the plants not in flower were great quantities of the following, viz. *Cornus Canadensis*, (known in Maine by the expressive name of *bunch berry*, from its beautiful bunches of scarlet berries; these berries are dry and insipid, but not unpleasant to eat;) the ivory berry, *Gaultheria hispidula* of Linnæus, of which Dr. Torrey has made a new genus; *Linnæa borealis, Streptopus roseus, S. distortus, Convallaria umbellulata, Panax quinquifolium, Coptis trifoliata, Tiarella cordifolia, Mitella prostrata;* and the following ferns, &c. were seen in fruit, viz.: *Polypodium dryopteris, P. connectile, Adiantum pedatum, Struthiopteris Pennsylvanica,* great quantities of *Pteris aquilina;* also *Lycopodium clavatum, L. complanatum, L. obscurum,* and *L. lucidulum.*

On the shore of the river I noticed the following plants growing abundantly, viz.: *Ranunculus repens, Campanula rotundifolia, Sagittaria sagittifolia,* and *Mimulus ringens;* also a very large specimen of *Orchis dilatata.*

We lost our way near Salmon stream, but after considerable labor effected a passage through the tangled bushes to the mouth of this creek, which we forded; after which we soon reached the first settlement above Matawamkeag Point, on this side of the river. Here we found a log cabin occupied by a family of Howards, who gave us a good supper and tolerable accommodations for the night. The Indian name of the settlement is Nickatow; its distance from "the Point" is about ten miles.

Wednesday, Aug. 10th.—This morning we proceeded to the next log hut on the same side of the river, and there crossed in a boat to the opposite side. I was much pleased by finding directly on landing great abundance of *Swertia deflexa;* I am not aware that this plant has been previously noticed as growing in New England. This locality is on the right bank of the Penobscot, just below the mouth of the East Branch, latitude about 45° 25′. The corolla of this plant is generally described as greenish yellow; I found, however, that before the ripening of the seed the corolla was dark blue, darkest on the spurs and shaded with green as in several of the Gentian tribe. The corolla does not become greenish yellow until the capsule has nearly ripened; but gradually increases in size and changes its hue until it finally withers, still adhering to the base of the ripened capsule. The latter when ripe is membranous, beaked, and splits half way to the base into two valves. In Dr. Beck's Botany I observe the remark, that this plant in drying turns black; this has not happened to my specimens, which retain their original color even better than is usual with dry plants. Our path lay next on the right bank of the river, and was fully as difficult as the one we had travelled upon the previous day. After going about six miles we arrived opposite "Dolby's," about six miles from Grand Falls. Here we found two log cabins, to which we went after crossing the river in a bateau belonging to one of them. After getting a miserable dinner we engaged two men to convey us in their boat to Grand Falls. We found the river very low, and had many opportunities of admiring the skill and coolness with which our boatmen managed their bateau, and forced it up rapids which at first seemed impassable. We stopped at the mouth of the Millinoket to fish for pickerel; while our boat lay here, I observed in the water great quantities of *Lobelia Dortmanna*, *Nymphæa odorata*, *Nuphar advena*, *Hydropeltis purpurea*, *Villarsia lacunosa*, *Eriocaulon pellucidum*, with stipes two or three *feet* long. The *E. pellucidum* is generally described as being but two or three *inches* in height; but the plants above referred to, as well as similar ones four feet long, which I have seen in ponds near Haverhill, Mass. do not appear to differ essentially from this species. The length of the stipe depends on the depth of water in which the plant grows. We also noticed here the leaves of a plant which I believe is *Sparganium natans*, Smith; these leaves were "long, floating, flat, and pellucid," about one fourth of an inch wide, and from eight to ten inches in length. It grows abundantly in all the upper lakes of the Penobscot. A short time after we reached the settlement at Grand Falls, we were agreeably surprised by the arrival of Prof. Barnes, who had set out from Matawamkeag Point in pursuit of us that morning, and performed on foot in one day the same distance for which we took part of two. We gave him a hearty welcome, and this evening determined upon our plan of proceeding to the mountain. We engaged two athletic "loggers" named Mac Astlin to act as guides and boatmen, and agreed to pay each two dollars per day for his services.

At Grand Falls, the only settlement consists of two log huts, occupied by persons engaged in logging. They cultivate but little ground, and have most of their supplies brought up the river in boats. In the smoky garret of one of these huts we passed the night, and rose early on *Thursday* to prepare for our journey. While waiting for our breakfast I was much pleased by discovering at this cabin—the very out-post of civilization in this direction—a well thumbed copy of Scott's Heart of Mid Lothian. "There's fame for you!"

Having each procured a blanket, a pound of pork and a pound of bread per day, a little tea and salt, and by a lucky thought, each taking a red flannel shirt, which afterwards proved very serviceable to us; we made our packs by means of our blankets, and then slinging them over our shoulders, we proceeded on the Portage or "Carrying Place," by the Grand Falls to reach our bateau, which was about three miles above. The appearance of our party as we filed through the woods, was very picturesque; our sturdy guide, Cyrus, led the van, having on his head a white felt hat, from which rains and time had long removed all stiffness, and which now formed a perfect cone, except where part of the brim was turned in over the forehead to give the eyes fair play. Over his shoulders was thrown an immense pack made of blankets, and containing provisions, &c., its color contrasting finely with his red flannel shirt. Around his waist was a broad leathern belt to which were buckled a couple of tin cups and a brass kettle. On one shoulder he bore his oars and paddles, on the other a frying pan, axe, &c. His brother followed, somewhat similarly equipped, carrying a fowling piece, &c., and we with our smaller packs, and some light articles, closed the procession.

On our way through the woods we again found the *Swertia deflexa,* and also passed over argillite in situ. This place, between Grand Falls and Quakish Lake, about three miles from the former, is the most northern point at which I have observed this rock.

When we launched our boat she was found to leak very badly, but we soon remedied this difficulty by scraping from her sides some of the superfluous pitch, which we placed upon her bottom; then by applying the heated frying pan the cracks were soon stopped, and we proceeded. Crossing the Quakish Lake and North Twin, we soon entered Lake Pemmidumkook; here we had a fine view of Katahdin, and could distinguish the various slides with which its sides are furrowed. At noon we went on shore to dine, and having made a fire at an old logging camp, we prepared our meal in campaign style, by each taking a large slice of fat pork, which we stuck upon sharpened sticks and then roasted until it was black. Pork thus cooked, with stale bread, and strong tea made in our brass kettle and swallowed without milk or sugar, formed our frugal fare, of which we partook with almost incredible relish. At this camp I was fortunate enough to find a pair of excellent moose skin moccasins, which were a great prize to me, as my boots were already worn through.

After dinner we embarked again, and proceeding by the Deep Cove and the Ambijeegis Lake and Falls, we stopped at night at the foot of the Passamagamet Falls, where, leaving Mr. Keely on the rocks to fish, the rest prepared for our night camp. Mr. Barnes and myself collected for our couch the fragrant boughs of the cedar, (*Thuja occidentalis,*) while our guides cut down bushes and pulled up their roots from the spot selected for an encampment. Our friend Cyrus in a few minutes chopped down a mighty hemlock, which fell with a tremendous crash; its trunk was to serve for our back log, against which we soon had a fine blazing fire. Four stakes supporting cross pieces, over which were thrown a couple of blankets fastened together by wooden pegs, formed a very comfortable tent, under which we spread a soft carpet of twigs.

Mr. Keely appeared presently with a fine mess of white perch and chub, which when fried, furnished us a delicious meal. The stump of the hemlock served as our table and the clean chips as plates. The whole scene formed a picture worthy of the pencil of Weir. During the night it rained hard, but our blankets proved sufficient protection. After a good night's rest we went forward again the next morning, (Friday,) having first caught and cooked for our breakfast another fine mess of fish.

At all the falls which we had passed since leaving Grand Falls, we found the rocks to be loose boulders of granite; but this morning we observed just below Debskoneegan Falls a large ledge of granite in situ. This is the most southern point where we had an opportunity of seeing it *in situ* during this journey. At these falls we were obliged to carry our boat a distance of about ninety eight rods, when we again launched her.

From Debskoneegan Lake the view of Katahdin is very fine. I have attempted in the accompanying sketch to give some idea of its outline. (See the fig.) The mountain on the right is Katahdin; (A) the large western slide, and (B) the eastern. The mountain on the extreme left is Sugar Loaf; it bears a striking resemblance to a volcanic mountain, of which the remarkable depression in its summit represents the crater. We were unable to determine whether this apparent hollowing out of the summit was real, or an optical deception produced by the receding ridge. Between the two principal slides (A) and (B), the chief growth upon the mountain appeared to be very low deciduous trees. These we afterwards found to be white birch, (*Betula populifolia.*) The eastern and western extremities of the mountain beyond the above mentioned slides, presented the dark green color of the evergreen pines and furs. The summit and a considerable space below, bare of vegetation. On the lower part

Outline of Mount Katahdin, as seen from Debskoneegan Lake.

A, West Slide.—B, East Slide.—C, Camp.—D, Sugar Loaf.

of the mountain we observed an appearance indicating horizontal terraces.

After taking the annexed sketch, and examining the plants near the shore, among which I found *Potentilla fruticosa* growing abundantly, we continued our route and soon arrived at the Pockwockamus Falls, which presented a very wild and picturesque scene. It is an immense collection of fragments of granite, rounded and polished by the action of the current, which in many places has, by the attrition of the gravel and pebbles, worn circular cavities in the rocks.

Upon the rocks are piled, in wild confusion, a great quantity of logs, which have formed at these falls a "*jam*," which the loggers had not been able to loosen. We noticed several places where the rocks had been blasted to liberate the lumber. It was with much labor that we transported our baggage over these rocks, while our boatmen forced the empty boat up the falls. The next falls we arrived at are called Abawljacarmegas, where a fine ledge of granite of the best quality is well exposed in the bed of the river.

We arrived early in the afternoon at Hoyt's stream, where we hauled our boat on shore, turned her over, and deposited under the bottom the greater part of our provisions, our gun, frying pan, extra clothing, &c.; then, having made up our packs with one blanket each, and a short allowance of provisions for two days, we proceeded on foot for the mountain, from whose base we estimated our distance to be about three miles. Our guides were now upon ground entirely new to them, neither of them having ever ascended the the mountain. We directed our course towards the slide marked (A) in the drawing. Having no path to direct us, we found our journey exceedingly difficult. The first part of our way was over a ridge where the woods had been burned; here our principal annoyance was caused by a very small black fly, which our guides called "*minges*," and to which the Indians give the appropriate name of "*No-see-'ems*." After leaving the "burnt woods," we descended into a dense cedar swamp, from which we extricated ourselves with much labor, and then soon struck upon a rapid mountain brook, which for the purity and transparency of its water, surpassed all I had ever beheld. We followed this stream a while, but finding that it was leading us from our course we left it and turned to the west, by doing which we soon arrived at the slide. Here a scene of wild confusion presented itself; masses of granite, shivered by their fall from above, lay scattered over the path of the slide; all traces of the original soil and vegetation were swept away, so that the denuded ledges of granite appeared in some places, while in others they were covered with great quantities of a coarse gravel, evidently produced by the crumbling of some of the coarse varieties of granite, much of which was seen in a state of partial disintegration. The flank of the mountain on which the slide is situated is covered with a low growth of white birch, (*Betula populifolia.*) Some small bushes of the same have sprung up in the path of the slide and in time will probably cover it.

At sunset we had ascended about one third of the height of the mountain, when finding the ascent very tiresome, we determined to encamp for the night. We selected for our camp a spot in the birch woods on the western edge of the slide, near which was a stream of excellent water. It was with much difficulty that we succeeded in making a small fire, our only fuel being the green trunks of the birch, and a few fragments of dead wood found in the slide. We felt very sensibly the want of the dry hemlock and cedar, which had so well served us for fuel the preceding evening. After supper we rolled ourselves up in our blankets, and with no canopy but the heavens, prepared for repose, for which the fatigues of the day had given us sufficient desire. The evening was clear, except a cloud which rested on the highest summit. During the evening some brilliant flashes of aurora borealis were seen.

Saturday, Aug. 13.—Our disappointment was very great this morning at finding ourselves surrounded by a drizzly mist, which threatened rain, and completely prevented our enjoying any view of the surrounding country. After waiting a while, in hopes of its clearing away, we commenced our ascent, placing ourselves abreast of each other that the stones which one might loosen should cause no injuries to the rest of the party. The slide near our encampment was about forty yards wide, narrowing very slowly towards the top. Soon after leaving our camp I discovered fragments of compact limestone containing distinct impressions of Terebratulæ. These were found in the path of the slide, but a slight examination convinced me that they were masses which had been deposited on the mountain by diluvial action. Mr. Keely informs that rolled masses of similar limestone have been found near Waterville College.

From the steepness of the mountain, the slipping of the loose stones and gravel, and the weight of our clothes drenched with the rain, our progress was slow, and very fatiguing; we toiled on, however, in spite of the rain, until we had reached a point about six hundred feet from the summit. By this time I became so much exhausted as to fear I would not be able to reach the summit, and have strength enough left to return to the boat that afternoon. Our time being limited, as well as our provisions, it was necessary that we should reach the boat that day; for fear therefore of detaining the party I determined very unwillingly not to exhaust my strength by ascending any higher. Had the day been fine there would have been more inducement to proceed; but we were enveloped in clouds, drenched with rain, and there was no prospect of the weather becoming such as to enable us to enjoy that view from the summit which is the principal inducement to reach it. Mr. Barnes with the two guides determined to proceed, while Mr. Keely and myself were to return to the camp and prepare a fire. Before descending, I examined the plants growing at the elevation which we had reached. I found the following in great abundance near the slide, viz.: *Ledum latifolium*, *Vaccinium Vitis Idæa*, *Vaccinium uliginosum*, and *Solidago virgaurea*, var. *alpina*. In the slide itself were large patches of *Potentilla tridentata*, and *Arenaria glabra*. (The *P. tridentata* is somewhat improperly called *Mountain potentilla;* it however flourishes within a few yards of the ocean, near the observatory at Portland.) We found also in descending, many bushes of *Ribes ringens*, whose berries, though ripe, were very nauseous at first; but my thirst made me persist in eating them, and I soon found them quite palatable. We examined the rocks in the slide while on our way to the camp, but found little of interest: fragments of shell limestone were not uncommon, besides which were many fragments of hornblende rock, graywacke, and amygdaloid. Some of the latter has a green paste resembling compact epidote; in this was once imbedded a substance which has decomposed, leaving the globular cavities which it once filled, nearly empty. The vesicular stone thus formed has a striking resemblance to a volcanic product. I also noticed many fragments of jasper of a fine red color. No indications of any ores were perceived.

When we arrived at our camp, we found our fire extinguished, and ascertained, much to our chagrin, that our friends had taken with them our only means of kindling one. The rain was increasing in violence, our only resource therefore, was to spread one blanket on the ground and another over it as a tent, by which we were partly sheltered from the storm. In about an hour we heard the merry shout of our comrades, who, thoroughly drenched, and much fatigued, soon arrived at camp. Mr. Barnes stated that the difficulty of the ascent increased greatly until he reached the ridge above the slide, along which he then proceeded without much trouble to the summit. On the very summit he found a fine bed of grass, and picked specimens of two plants, which I found to be *Vaccinium uliginosum* and *Empetrum nigrum*, both in fruit. He brought no specimens of the grass.

The summit rock, of which he brought down some specimens, is a reddish colored granite, containing small, well formed crystals of feldspar. It is stated in Williams's History of Maine, that on Katahdin, vegetation ceases a mile from the summit, and that the elevation is so great as to cause difficulty of breathing, as well as intense cold to be felt; Mr. Barnes contradicts this, having found vegetation on the summit, and not having perceived any great rarefaction of the air, or sensible reduction of temperature.

It is evident from this, that the height of this mountain has been greatly overrated. It has been variously estimated at from five thousand to six thousand four hundred feet above the level of the sea. It was our intention to have measured its height, but unfortunately we could not procure a mountain barometer either in Waterville or Bangor.

Before we descended from our camp, the clouds rose a little, so as to give us a fair view of some of the numerous lakes with which the region abounds. We could distinguish Millinoket, Debskoneegan, Pemmidumkook, &c. In descending, we passed numerous horizontal terraces which appeared to extend along the flanks of the mountain beyond the slide.

When we had descended nearly to the point where we had first entered the slide, we turned to the left, and pursued a southerly course; but in the endeavor to avoid the swamp which the day previous had caused us so much trouble, we lost our way and became entangled in several dense sphagnous swamps, in which was a thick growth of cedar, (*Thuja occidentalis*,) through which it was very difficult to effect a passage. Often we would completely lose sight of each other, and be obliged to shout to our guides to stop, for fear we might part company. The heavy rain in the morning had completely drenched the trees and bushes, so that every one we touched sent down upon us a shower, which soon wet us to the skin. Climbing over fallen trees, stumbling at tangled roots, now by main force making a passage through the bushes, and anon falling prostrate, as some rotten branch gave way, to which we had trusted for support, we at last reached the "burnt wood," with much less clothing upon us than when we began our journey. None of us, not even our guides, who were experienced woodsmen, were ever on so fatiguing a journey. Had we trusted entirely to our pocket compass, we might easily have returned to our boat by the same route by which we left it, but in the endeavor to avoid one swamp we got into a dozen, besides adding several miles to the length of our route. In the burnt wood we advanced with more ease, but before we reached the river we were again obliged to enter a difficult swamp. We finally struck the river a few rods above our boat, and were as much rejoiced to see it as was ever sea-sick traveller by beholding shore. The plants which I had an opportunity of noticing around the base of Katahdin during our hasty return, were the following, viz. *Monotropa uniflora*; *Pyrola secunda*; *Pyrola umbellata*; *Dalibarda repens*; *Cornus Canadensis*; *Epilobium spicatum*; *Convallaria trifolia*; *Gaultheria hispidula*; *G. repens*; *Streptopus roseus*; *S. distortus*; *Ledum latifolium*; *Kalmia angustifolia*, and *Sorbus Americana*. This last is sometimes called Round wood, because the stem is so perfect a cylinder.

On the shores of the Penobscot, near our landing place, I observed in the same abundance as at the lakes below, *Ranunculus repens*; *Potentilla fruticosa*; *Campanula rotundifolia*, and *Spartina cynosuroides*; to the latter our boatmen gave the name of "Blue Joints." In the stream were great quantities of *Lobelia Dortmanni*; *Eriocaulon pellucidum*, and *Sparganium natans*.

This night we encamped at the head of the Debskoneegan Carrying Place, where we found a small camp made of hemlock bark, which required but little adjusting to render it very comfortable. We made a large fire to dry our clothes and blankets, and then lay down for the night. In the morning (Sunday) I found myself suffering from a violent cold in my throat, which however had no serious consequences. Making a hasty breakfast, we again set out, eager to reach the Grand Falls before night. Whenever we were in still water we used both paddles and oars, and thus made rapid progress. We were particularly struck, during this day's journey, with the remarkable purity and transparency of the water, as well as the beauty and accuracy of the reflections from its surface. Every leaf and branch of the trees was distinguishable, and the rounded rocks, projecting above water, appeared like globular masses of some light substance afloat, and it was almost impossible to distinguish the dividing line between an object and its image.

A solemn stillness reigned upon these lakes, broken only by the sound of our paddles, the wild laugh of a loon, or cry of a white eagle which we occasionally startled from his perch on some lofty pine.

Near Hoyt's stream, however, we heard one "sound familiar to our ear;" it was the tinkling of cow bells, which we found were fastened to some fine oxen grazing on the islands in the stream. They belonged to Mr. Gibson, who has a camp farm at Sowadahunk, six miles above our landing place. We met him in his boat as we were descending the river; he was carrying up some men to cut the wild meadow hay, which is in great demand in this region during winter, when the woods are filled with "loggers" and their cattle.

Nothing worth recording occurred during the remainder of our journey to Grand Falls, where we arrived before sunset. The next morning, Monday, we engaged our faithful guides to transport us in their boat to Matawamkeag Point, where we arrived about three o'clock, P. M. with our relish for the comforts of civilization much heightened by our excursion. We returned, via Bangor, &c., to Waterville, and on calculating our expenses, found them to have been but twenty five dollars each, including the hire of the horse and wagon.

Before closing this article, I wish briefly to mention the places at which I have had an opportunity of observing the Argillite so often alluded to in the above article. During this journey it was the only rock seen *in situ*, from Waterville, east to Bangor, and thence north and north westerly to a point between Grand Falls and Quakish Lake. I observed it on an excursion made on foot to Mount Abraham in 1832, at the following places: from Waterville all the way to Norridgewock, where it forms the falls; and in Starks, Industry, Freeman, Kingsfield, and Anson. The only other rock observed, was a small hill of granite between Starks and Industry, and the granite forming the summit of Mount Abraham.

I have merely stated above the places where I have myself had an opportunity of examining the Argillite formation. It doubtless extends far beyond the limits of my observations, and as it is said to occur at Holton, it is not improbable that it traverses the whole state in a north easterly direction, and enters into New Brunswick. This formation appears very deficient in mineralogical interest. I have not seen in it any minerals, except quartz and sulphuret of iron. In some places it furnishes good roofing slate, and I have been informed that a vein of limestone occurs in the rocks near Ticonic Falls at Waterville, but I had not an opportunity of examining this place. I have called the formation Argillite from its *prevailing* character, although in some places it resembles talcose slate, and at others graywacke.

I think it worthy of remark, that the valley of the Kennebeck, from Waterville, as far north as I had an opportunity of observing during my visit in 1832 to Mount Abraham, is covered with boulders of granite, of so peculiar a character that they may perhaps some day be traced to their original position. These boulders differ from those observed on the Penobscot, by containing large imbedded crystals of white feldspar, which make the masses appear at a little distance as if they were covered with *broad chalk marks.* These crystals are generally about three inches long and one fourth of an inch wide. I have seen some, however, five inches long by four wide.

I hope soon to be able to send you an account of the botanical observations which I have made in the vicinity of Waterville: in the mean time I send this hasty article, hoping that the few facts it contains respecting the geology and botany of the regions visited, will be received with interest, on account of the few notices which have hitherto been published upon these departments of the natural history of Maine.

West Point, Aug. 31, 1836.

Art. III.—*Experiments on the Adhesion of Iron Spikes of various forms, when driven into different species of Timber;* by Walter R. Johnson, Professor of Mechanics and Natural Philosophy in the Franklin Institute, Philadelphia.

In reference to rail-road constructions, bridge-building, and several other useful applications in civil engineering, as well as in naval architecture, the adhesion of spikes, bolts and nails of various forms becomes an object of much practical importance. In regard to railroads, this matter is worthy of more attention than might at first sight be supposed. Owing to the high price of iron, the flat rail is often unavoidably adopted in preference to the edge rail; and whenever the speed of a train descending by gravity, or impelled with great velocity by the moving power, is to be suddenly checked by the brake, the friction of the periphery of the wheel on the rail, tends to drive the latter lengthwise, and thus to force all the spikes with which it is fastened into closer contact with the ends of the fibres which have been cut in driving them. If this partial or total dragging of the wheels along the rails take place, sometimes in one direction, and sometimes in the other, the spikes must be subjected to alternate impulses on opposite sides. Indeed, whenever the motive power depends on friction for its efficacy, as in the case of the common locomotive engine, there is a constant succession of these two opposite dragging forces, the engine constantly tending by its driving wheels to urge the rail backwards, and the train by an equal but more extensively distributed action tending to urge forward all the rails over which it is at the same moment passing. So decided is this influence, that on a rail road where the transportation is all in one direction, and where the cars descend by gravity, I have seen rails entirely detached, or remaining loosely connected but by a single spike, while others clearly indicated by the inclined position of their upper faces or heads, that they were pressed into an oblique or leaning position in the wooden sill.

This single case may serve to show the importance of attending to the character of the spikes used in similar constructions.

To determine some of the points relating to the forms of spikes, and the kind of timber into which they are driven, the following experiments were undertaken. They serve to show the relative economy of each form of spike, as well as its fitness for the purpose intended. The mode of executing the experiments was, to drive each spike to a certain distance above its cutting edge, into the edge of a piece of plank or scantling, and by means of a suitable apparatus, adapted to that purpose, to draw it out by a direct longitudinal strain. The machine employed for this purpose was the same as that which has been used for testing the strength of iron and copper, in experiments on the tenacity of materials employed in steam boilers. A strong band or strap of iron, connected with the weighing beam of that machine, held the piece of plank, and a clamped pincers, with a suitable jaw, for taking hold of the head and projecting part of the spike, was attached to the opposite part of the machine, which being tightened by a strong screw held the spike firmly, while the application of weights upon the long arm of the lever drew the timber away, and released the spike. Care was taken to cause the strain to pass through the axis of the spike, and, by a very gradual application of weights, to avoid surpassing that force which was just sufficient for its extraction.

The first experiment was upon one of Burden's patent square spikes, with a cutting edge, intended to be in all cases placed across the grain of the timber. This spike was .375 of an inch square, and was driven into a sound plank of seasoned New Jersey yellow pine, $3\frac{3}{8}$ inches. The force required to extract it was 2052 lbs. and the exact weight of the part driven into the wood was 866 grains troy.

The second trial was upon a flanched, grooved and swelled spike, having the grooves between two projecting wings or flanches, on the same sides as the faces of the cutting edge. The other two sides were planes, continuing to the head. A cross section of this spike, taken $1\frac{3}{4}$ inches above its edge or point, had the form of fig. 1. At $\frac{8}{10}$ of an inch, that is, where the flanches project least from the edge, or where the swell between them comes nearest to forming a perfect square, the form is as shown in fig. 2; the dotted line *e e*, in each figure, representing the direction of the cutting edge. Towards the head of this spike, the flanching and grooving is suppressed, and the form becomes a square. This experiment was made on the same piece of Jersey yellow pine as the first, and the weight required for extracting the spike was 1596 lbs. The weight of the part driven in was $708\frac{1}{4}$ grains. The cutting edge was irregular; the distance to which it was driven, was $3\frac{3}{8}$ inches, as in the first trial. To know the relative value of the two forms of spikes, we have but to divide the weight required for the extraction of each by the number of grains in the part which had been buried in the wood; thus, $2052 \div 866 = 2.37$, and $1596 \div 708.25 = 2.112$. Hence the plain spike had an advantage over the swelled and grooved one, in about the proportion 23 to 21. It should be mentioned also, that the plain spike was drawn out by a very gradual addition of force, whereas the force of 1596 lbs. drew the grooved spike immediately after its application. In the first trial, an attempt was made to detect any yielding or gradual retreat of the spike, before the final start, but none was observed.

Fig. 1.

Fig. 2.

The third and fourth experiments were made with the same spikes respectively as the first and second; but instead of yellow pine, the timber employed was thoroughly seasoned white oak.

The plain spike driven $3\frac{3}{8}$ inches into that timber, required for its extraction a force of 3,910 lbs. and, as before, exhibited no signs of movement until the instant of starting, when it suddenly came out about $\frac{1}{4}$ of an inch, or as far as the range of motion and the elasticity of the machine would permit.

The flanched, swelled and grooved spike, driven $3\frac{3}{8}$ inches into another part of the same piece of plank, from which the plain one had been extracted, was drawn out with a force of 3,791 lbs. A slow motion to the extent of $\frac{1}{25}$ or $\frac{1}{20}$ of an inch was, in this trial, perceived to precede the starting of the spike; and was accompanied by a gradual protrusion of the fibres of the timber immediately around the iron. In these experiments, though the plain spike bore the greater absolute weights, yet when the weight of metal is considered, it is seen that the relative values of the two are 4.515 in the plain, and 5.354 in the grooved form. The various circumstances of the four preceding experiments are seen at a single view in the following table.

TABLE I.

No. of experiments.	Description of spike used.	Kind and condition of timber.	Breadth of spike. Inch.	Thickness of spike. Inch.	Depth to which it was driven. Inch.	Weight in grains of part driven in.	Force required to extract it in lbs. avoirdupois.	Ratio of extracting force to weight of spike.	Date.	REMARKS.
1	Burden's. plain sq. spike.	Season'd Jersey yellow pine.	.375	.375	3.375	866	2052	2.368	1835. Oct. 27.	Force gradually applied, no motion previous to the starting.
2	Flanched, grooved and swelled.	Season'd Jersey yellow pine.	.375	.300	3.375	708	1596	2.254	"	Force applied at once.
3	Burden's plain.	Season'd white oak.	.375	.375	3.375	866	3910	4.515	"	Started suddenly.
4	Grooved and swelled.	Season'd white oak.	.375	.300	3.375	708	3791	5.354	"	Fibres protruded $\frac{1}{20}$ inch before spike drew out.

Hence it appears, that in yellow pine the grooved and swelled form was about 5 per cent. less advantageous than the plain, while in the seasoned oak the former was 18½ per cent. superior to the latter. It is also apparent that the advantage of seasoned oak over seasoned yellow pine for retaining spikes, is, by a comparison of experiments 1 and 3, as 1 to 1.9; and by a comparison of 2 and 4, it is as 1 to 2.37. In the preceding experiments the spikes were driven into the timber and immediately drawn out again. In the second series, the spikes were driven into their respective pieces of timber, and then soaked for a few days in water. The pieces into which the different spikes were driven, were as nearly alike as it was practicable to obtain them, being always cut from the same plank, avoiding knots, cracks, &c. The following table contains a view of the experiments after soaking the timber.

TABLE II.

Timber soaked after the spikes were driven.

No. of experiments.	Kind of spike used.	Kind and condition of timber.	Breadth of spike.	Thickness of spike.	Depth to which it was driven.	Weight in grains of the part inserted.	Force to extract the spike in lbs.	Ratio of the extracting force to the wt. of spike.	Date.
			Inch	Inch	Inch				
1	Swelled and grooved.	Chestnut unseasoned.	.375	.300	3.5	806.	1710.	2.121	1835 DEC. 3
2	" "	Yellow pine seasoned.	.375	.300	3.5	806.	1668.	2.069	"
3	" "	Hemlock partly season'd	.375	.300	3.5	806.	1738.	2.156	"
4	" "	White oak seasoned.	.375	.300	3.5	806.	3373.	4.184	"
5	" "	Locust partly seasoned.	.375	.300	3.5	806.	4902.	6.081	"
6	Swelled and grooved, the swell filed away.	Chestnut unseasoned.	.390	.300	3.5	759.	1852.5	2.440	"
7	" "	Seasoned yellow pine.	.390	.300	3.5	759.	1767.	2.328	"
8	" "	Hemlock partly season'd	.390	.300	3.5	759.	1296.8	1.576	"
9	Plain spike, filed lengthwise.	Chestnut unseasoned.	.400	.394	3.625	933.5	1790.	1.810	"
10	" " "	Hemlock partly season'd	.400	.394	3.5	933.5	1638.75	1.755	"
11	" " "	Locust partly seasoned.	.400	.394	3.5	933.5	3990.	4.167	"
12	" " "	" " "	.400	.394	3.5	933.5	4332.	4.640	"
13	Grooved and notched, or serrated.	White oak.	.392	.315	3.675	759.	2622.	3.454	"
14	Burden's patent.	" "	.339	.329	3.625	639.	2152.	3.367	"

REMARKS.

Experiment No. 1.—In this and the four following, the thickness of the spike is that at the bottom of the grooves.

Experiment No. 4.—The oak used in this experiment was firmer than that employed in the first series.

Experiment No. 5.—The timber had been slightly split by the driving of this spike.

Experiment No. 6.—The flanches remained after filing out the swelled part of the original form.

Experiment No. 12.—Timber slightly split in driving the spike.

The first five of the preceding experiments show that with a spike of given form, and driven a certain distance into different timbers, the order of retentiveness, beginning with the highest, is as follows: 1, locust; 2, white oak; 3, hemlock; 4, unseasoned chestnut; 5, yellow pine. From the 6th, 7th and 8th experiments, we see that chestnut is still above yellow pine, but that hemlock is inferior to both. By the 9th and 10th, it also appears that hemlock is still to be placed below chestnut. Comparing the 1st experiment in this table with the 6th, and the 2nd with the 7th, we perceive that the swell towards the point of the spike, was so far from being an advantage to it, that it in fact rendered the spike less retentive than when that swelled part had been removed; so that, even could this form have been produced without any increase in the weight of the spike, it would still have been less advantageous than the simple groove without the swell: but when it is considered that the swell added 47 grs. $(=806-759)$ to the weight, it is evident that the groove alone has a decided advantage over the other form. By the trials in unseasoned chestnut, (Nos. 1 and 6.) this advantage is 15 per cent.: thus $\frac{2440-2121}{2121}=15$; and by those on yellow pine, (Nos. 2 and 7,) it is $\frac{2328-2069}{2069}=12.5$ per cent. In fact, after the ends of the fibres have once been thrust apart by the thick part of the swell, it is evident that when they come opposite to the cavity above the swell they must lose some portion of their power to press the spike and produce the retaining force of friction; this force must then depend for its production on the action of those fibres of the wood which are opposite to the swelled portion, or between it and the point of the spikes.

In the next series of experiments, it was attempted to ascertain the relation between forms more diversified than had hitherto been employed.

As it is evident that the total retentiveness of the wood must depend, in a considerable degree, upon the number of fibres which are longitudinally compressed by the spike, it was inferred, that on the area of the two faces, which in driving the spike are placed against the ends of the fibres, must in a great measure depend the retention of the spike. In this series, four kinds of wood and ten forms of spikes were employed.

A comparison of the results given in the following table, will show what order those forms would possess among themselves, in point of retentiveness, as well as the advantages of the respective species of timber into which they were severally driven.

TABLE III.

Spikes of various forms—timber of different kinds.

No. of Experiments.	Kind of spike used.	Kind and condition of timber.	Breadth of spike.	Thickness of spike.	Area of two faces.	Depth to which driven.	Weight of parts inserted.	Force to extract spike.	Ratio of force to weight of spike.	Date.
			Inch.	Inch.	Sq. in.	Inch.	Grs.	Lbs.		
1	Straight square.	Chestnut unseason'd.	.405	.402	2.83	3.5	942	1995	2.116	1835. Dec. 4.
2	Burden's patent.	"	.373	.384	2.64	3.5	866	1873	2.162	Dec. 8.
3	Broad flat.	"	.539	.288	3.77	3.5	898	2394	2.663	Dec. 4.
4	Narrow flat.	"	.390	.253	2.73	3.5	566	2223	3.927	Dec. 8.
5	Straight square.	White oak thoroughly seasoned.	.405	.402	2.83	3.5	942	3990	4.129	Dec. 7.
6	Broad flat.	"	.539	.288	3.77	3.5	898	5130	5.712	"
7	Narrow flat.	"	.390	.253	2.73	3.5	566	3990	7.049	"
8	Burden's patent.	"	.373	.384	2.64	3.5	866	3905	4.509	"
9	Cylindrical, with cutting edge.	"	.485	Diam.		3.5	1211	3876	3.200	"
10	Grooved and swelled.	"	.375	.375	2.60	3.5	806	3727	4.624	"
11	Grooved, but not swelled.	"	.375	.375	.260	3.5	759	4247	5.662	"
12	Grooved, and bottom of grooves serrated.	"	.375	.375	.260	2.5	500	2650	5.300	"
13	Square.	Locust seasoned three years.	.405	.402	2.83	3.5	942	5967	6.334	Dec. 8.
14	Broad flat.	"	.539	.285	3.77	3.5	898	7040	7.839	"
15	Narrow flat.	"	.390	.253	2.73	3.5	566	5273	9.316	"
16	Cylindrical, pointed with 15 grooves filed longitudinally from the point upwards.	Ash seasoned.	.500	Diam.		3.5	929	2052	2.208	1836. Jan. 4.
17	"	"	.500	"		3.5	929	2309	2.507	"
18	Plain, cylindrical, pointed, scale not removed.	"	.500	"		3.5	1015	2451	2.414	"

REMARKS.

Experiment No. 10.—The measures in this and the two following cases were taken outside the flanches.

Experiment No. 12.—The weight of the part inserted is given by estimation in this experiment.

Experiment No. 16.—In this and the two following experiments, the spikes were driven into the timber in the direction of the length of the fibres.

The above table furnishes three sets of comparisons for deducing the relative retaining powers of green chestnut, thoroughly seasoned oak, and equally seasoned locust. Thus the weight which in those three cases drew the square spike from chestnut, was 1995; and that which extracted the broad flat one 2394; and that which drew the narrow flat one from the same timber was 2223. The sum of these is 6612. The sum of the three numbers for the same three spikes used with oak, was by experiments 5, 6, and 7, 13110; and the sum of the three in locust, by experiments 13, 14, and 15, is 18280; these three numbers have to each other the relation of 1, 2, and $2\frac{3}{4}$; from which we infer that oak is almost precisely *twice*, and locust $2\frac{3}{4}$ times as retentive as unseasoned chestnut. By comparing together the results of experiments 1 and 2, it will be seen that the weights required for extracting the two spikes respectively, are more nearly proportional to the breadth than to either the thicknesses, or the weights of the spikes. For the spike with a breadth of .405 inch and a thickness of .402, required 1995 lbs. for its removal, while that which had a breadth of .375 inch took 1873 lbs. Now .373 : 405 : : 1073 : 2033 for the calculated retentiveness, instead of 1995, as given by experiments;—a difference of only +38 lbs. between the observed and calculated results. Calculating the retention by the *weights* of the respective spikes, we should have 866 : 942 : : 1873 : 2987, or a difference of 42 lbs. while using the thickness alone, we obtain .384 : 402 : : 1873 : 1960, a difference of an opposite kind of 35 lbs. from the observed result, the greater thickness yielding the less retentive power. This correspondence between the breadths and the extracting weights becomes still more apparent when we compare the third, and especially the fourth with the second experiment. Thus for the broad flat spike, (3d Ex.)—compared with experiment 2, we obtain

By breadths,	.373 : 539 : : 1873 : 2701,	instead of 2394, diff.	+ 307
" weights,	.866 : 898 : : 1873 : 1942,	" " "	− 452
" thicknesses,	.384 : 288 : : 1873 : 1379,	" " "	− 1015

and for the thinner and lighter spike, (Ex. 4th.)—compared with the same,

By breadths,	.373 : 390 : : 1873 : 1958,	instead of 2223, observed diff.	− 265
" weights,	.866 : 566 : : 1873 : 1224,	" " " "	− 999
" thicknesses,	.384 : 253 : : 1873 : 1234,	" " " "	− 989

Nearly the same conclusions would result from a comparison of those trials, which were made on seasoned white oak and locust. Indeed, it appears that with a given breadth on the face of the spike, a diminution of thickness is sometimes a positive advantage to the retentiveness of the timber; for in white oak, the spike which had a breadth of only .390, required as much force to extract it, as one of which the breadth was .405, though the thickness of the former was but .253, while that of the latter was .402; and on chestnut, the thinner, narrower, and lighter spike, required absolutely more force to withdraw it than the other. This leads us to notice the different kinds of action of the respective spikes on timber of various kinds. In the softer and more spongy kinds of wood, the fibres instead of being forced back longitudinally and condensed upon themselves, are, by driving a thick, and especially a rather obtusely pointed spike, folded in masses backward and downward so as to leave in certain parts the *faces* of the grains of the timber in contact with the surface of the metal.

That the view just presented is correct, seems also probable from what was observed in the case of the swelled spike. For while the grooved but unswelled one, driven into chestnut timber, (table II. Ex. 6,) required 1852 lbs. to extract it, the grooved and swelled spike, (Ex. 1, same table,) took but 1710 lbs. And in table III. Ex. 11, we find the swelled spike drawn from white oak by 3727 lbs. and the grooved but not swelled one, Ex. 12, requiring 4247. Hence it appears to be necessary, in order to obtain the greatest effect, that the fibres of the wood should press the face as nearly as possible in their longitudinal direction and with equal intensities throughout the whole length of the spike. Arranging the spikes according to the order of their ratios of retention to weight, as given by the experiments in table III, from five to twelve inclusive, we have the following:

1.	*Narrow flat spike,* with a ratio of . .	7.049
2.	*Wide* " " " " " . .	5.712
3.	*Grooved but not swelled,* " " . .	5.662
4.	*Grooved and notched,* " " . .	5.300
5.	*Grooved and swelled,* " " . .	4.624
6.	*Burden's patent,* " " " . .	4.509
7.	*Square hammered,* " " " . .	4.129
8.	*Plain cylindrical,* " " " . .	3.200

Experiments 16, 17 and 18, of the same table, were made by driving the spikes which were cylindrical with conical points into the timber endwise of the grain. This method of comparing two forms, the one grooved and the other plain, was adopted on account of the extreme liability of the timber to be split by driving spikes of these forms *across* the direction of the fibres. It was observed that on drawing these spikes, the holes were almost perfectly square. This resulted from the position of the rings of annual growth and the greater elasticity in some directions than in others. It is probable that if the filed grooves in experiments 16 and 17 had been covered with a scale of oxide, as was the case with the plain spike used in experiment 18, the former would have given a result somewhat higher.

When holes are drilled into stone blocks and afterwards plugged with timber to receive spikes in fastening on the chairs of edge rails, the method of experimenting just described finds an application, and it is probable that in such cases the grooved cylinder with a conical grooved point, may prove advantageous.

A few experiments were made to determine the effect of driving to different depths, on the total amount of retention. For this purpose two different spikes were selected, viz. the square hand-wrought spike, the section of which was $.405 \times .402$, and the wide flat one of which the section was $.539 \times .288$. They were respectively driven to a certain depth into unseasoned chestnut, and then subjected to a force just sufficient to start them. This force was noted, and the spike was immediately driven down one inch deeper than before, and the force again applied. All my experiments proved that when a spike is once started, the force required for its final extraction is much less than that which produced the first movement. This is readily accounted for on the principle that as the wedge-shaped point was from half an inch to an inch in length ; and as this, on the starting back of the spike a very little distance, became mostly relieved from the pressure of the fibres, all that part of the retention which had been due to the wedge-shaped portion of the spike was at once destroyed. The following table will show, however, that the mere starting of the spike with parallel faces does not essentially diminish the retention, when again driven into the timber to a greater depth than before. But when a bar of iron is spiked upon wood, if the spike be driven down until the bar compresses the wood to a great degree, the recoil of the latter may become so great as to start back the spike a short distance after the last blow has been given. In this case a great diminution in the useful effect will be the consequence. This shows that a limit may exist to the force which we should apply in urging down spikes or bolts destined to fasten materials together.

TABLE IV.

Spikes driven to different depths.

No. of the Experiments.	Form of spike.	Kind and condition of timber.	Breadth of spike.	Thickness of spike.	Area of the two faces pressing the ends of fibres.	Depth to which spike was driv'n.	Weight of the part inserted.	Force to extract the spike.	Ratio of force to weight of spike.	Date.
					sq. in.	inches.	grs.			1835.
1	square not filed.	chesnut unseasoned.	.405	.402	.7695	1.9	483	1183	2.428	Dec. 4.
2	" " "	"	"	"	1.1745	2.9	789	1995	2.528	"
3	" " "	"	"	"	1.5795	3.9	1095	2565	2.342	"
4	Broad flat.	"	.539	.288	.9702	1.8	442	1525	3.457	"
5	" "	"	"	"	1.5092	2.8	745	2594	3.482	"

By comparing experiments 1 and 4 together, it will be found that weight for weight, the flat spike had when driven 1.8 inches, an advantage of 42.3 per cent. over the square one; and by a like comparison of experiments 2 and 5, it is evident the former had a superiority of 37.7 per cent. As the spike when driven in only 1.9 inches had a much less proportion of its parallel faces exposed to the reaction of the fibres and a greater proportion of the wedge-shaped point, it is reasonable to expect that the retention would not correspond precisely with the lengths inserted. It will be understood that when we speak of *cutting edges* and the wedge-shaped portion of spikes, whether square, flat, or cylindrical, the direction of the cutting edges is always across the fibre or grain of the timber. It must be evident that the wedge-shaped part may be so acute, as to correspond nearly with two parallel faces, in which case, the tendency to retreat from the lateral pressures is small; and the pressures themselves, increasing from the point upwards to where the spike is thickest, the total efficiency of a given length may be as great as that of an equal length of the parallel faces, and even greater, provided the thickness of the spike be so considerable as in driving it to produce much crushing and irregular folding of the fibres of the timber. If, on the other hand, the edge be very blunt, the tendency to recoil may be such as to diminish the adhesion, and in this case the effect of the wedge shape is negative. In the other it may be positive.*

* The following formula may represent the several experiments; $R = lf \pm c$, in which R is the observed retention; $l =$ the length in inches of the part inserted; $f =$ the force of retention on one inch of the parallel faces, and $c =$ the difference between the retention of a parallel portion of the spike, and of an equal length of the converging faces near the point. The sign of ambiguity arises from the cause above explained.

The *first*, *second* and *third* experiments indicate, in the tenth column of the preceding table, that beyond a certain limit the ratio of *weight of metal* to extracting force begins to diminish, showing that it would be more economical to increase the number rather than the length of the spikes, for producing a given effect in fastening materials together. In this case, also, it will be perceived, that the adhesion has a much closer relation to the areas of the compressing faces of the spikes, than to their weights. For three of the experiments this ratio may be regarded as identical, and dividing, for each of the five experiments, the observed retention by the area of the two faces opposed to the ends of the fibres, we get a mean result, which proves that the absolute retaining power of unseasoned chestnut, on square or flat spikes of from 1.8 to 3.9 inches in length, is about 813 lbs. for every square inch of those faces which condense longitudinally the fibres of the timber.

Art. IV.—*Remarks on the Natural order Cycadeæ, with a description of the ovula and seeds of Cycas revoluta, Willd.;* by A. J. Downing.

[Read before the Lyceum of Natural History, New York, Oct. 17, 1836.]

Cycas revoluta, figured in the accompanying plate, (Plate I.) belongs to a genus comprising but four other known species, which together with *Zamia* constitute the *Cycadeæ*, one of the smallest but most interesting orders in the whole vegetable kingdom. Their singular structure and manner of growth, their simple cylindrical stems and crowning tufts of foliage, like some of the Palms, and their commonly gyrate vernation, like that of most Ferns, as well as their anomalous inflorescence and fructification, have rendered them objects alike of the greatest interest and perplexity to the learned botanists who have examined them.

Cycas circinalis, Willd., a native of Malabar and Japan, seems to have been the first species discovered, having been described by Rheede, as early as 1682.* Rumphius,† in 1741, figured and described it under the name of *Olus calappoides:* he remarks its resemblance to the arborescent Ferns, and thinks it might with propriety be called *Osmunda arborescens.* Linnæus, who first gave the genus its present name, seems, from the imperfect manner in which its structure was known in his time, to have been greatly at a loss

---

* Hort. Malab. vol. iii, p. 9. † Herb. Amboiense, vol. i, p. 87.

where to place it; for we find it first arranged by him among the Palms, and afterwards with the Ferns. It was not until the year 1807, after the suggestions of Ventenat, that the natural order of Cycadeæ was established, it having been first characterized by the elder Richard, in Persoon's Synopsis Plantarum.

C. revoluta, though of late years well known in the fine living collections of England and the Continent, appears to have produced its flowers but rarely. The description and plate,* by Sir J. E. Smith, taken from a specimen which flowered in the hot-houses of the Bishop of Winchester in 1779, and the plant at Wentworth House, mentioned as being in a state of inflorescence in 1829, by Sir Wm. J. Hooker, and figured in the Botanical Magazine,† (both of which notices are now considered imperfect in their views of the structure of the stem and seeds,) are all that have come under our observation.

In Japan, the native country of this species, its curious fructification is, we believe, renewed annually; and the Japanese, who make considerable plantations of it around their houses, are said to eat the seeds and extract an inferior kind of sago from the pith or central part of the stem; whence it has received the name of Sago Palm, although the true sago of the shops is the production of a very different plant, the *Sagus Rumphii*, Willd., which is a true Palm. According to Dr. Hamilton,‡ the flour used by the poorer natives of Malabar, called *Indum Podi*, is prepared from the seeds of a species of Cycas, dried and beaten in a mortar.

For a long time, those who examined this group of plants seem to have been more occupied with their external appearance, as exhibited in the fine pinnated foliage and simple trunk of Cycas, than with any minute investigation of the real nature of the reproductive organs. When, however, the plants of this order were attentively examined as to their germination, their mode of inflorescence, and especially as to the nature of those singular bodies denominated the female flowers, new light was thrown upon their characters and affinities. To that learned and most accurate botanist, Robert Brown, we are mainly indebted for those views which explain the true structure of Cycadeæ, and establish an intimate relationship with the apparently very different group of plants, known under the name of Coniferæ. These views were presented to the world in a paper read before the Linnæan Society of London, in 1825, on the "structure of

* Trans. Linnæan Soc. of London, vol. vi, p. 312.
† Bot. Mag. tab. 2963.
‡ Travels in the Mysore, vol. ii, p. 469.

the female flowers in Cycadeæ and Coniferæ."* The elder Richard, in his admirable "*Mémoire sur les Conifères et les Cycadées,*" prepared about the same time, and published afterwards by his son, had indeed, with great ingenuity, established the affinity between Cycadeæ and Coniferæ; but his views respecting the female flower and seed of both these tribes differ widely from those of Brown, and are now generally admitted by the first botanists to be erroneous. The female flower of these orders consists, according to Richard, of a monosepalous perianth or calyx, enveloping or adhering to an unilocular ovarium, which contains the true seed. He considers the aperture at the apex of the outer coat to be the style, and the projecting point of the second, the stigma. Brown, on the contrary, suggested that the calyx, &c. of Richard, are but the membranes of the ovula, and in the mature state the integuments of the seed; in short, that the bodies called by Richard and other writers the female flowers, are *naked ovula,* borne upon the margins of a contracted leaf, which last may be considered as an imperfect and open ovarium. The impregnation he supposed to take place through the foramen of the ovulum, (the perforated stigma of Richard,) there being (contrary to the usual structure in phenogamous plants) no style or stigma through which the pollen can find its way to that body. These ideas, so startling and paradoxical at first sight, were slowly received even by the most acute botanists, but have finally been almost universally adopted. The so-called naked seeds of Linnæus having been demonstrated to be one-seeded fruits, it appears that the Cycadeæ and Coniferæ alone have the peculiarity of producing truly naked seeds, and that they compose therefore a distinct natural group, to which the name of Gymnospermæ has very appropriately been given.

Aside from an examination of the ovula themselves, and their integuments, the botanist who studies the structure of the organs of reproduction in Cycadeæ, cannot but be convinced, that what were formerly called pistillate flowers are simply ovula in the first place, and afterwards naked seeds. The modified leaf, bearing the ovula upon its face or margin, is undoubtedly a carpellum in an imperfect state of development, the seeds of which would be enclosed in an ovarium, if the edges of that carpellary leaf were folded together in the usual manner. In *Cycas circinalis,* the ordinary appearance of the pinnated leaf is so far departed from as to exhibit in fact a flat

* Vide Appendix to Capt. King's Voyage, p. 22.

scale-like carpel, with the rows of ovula upon either margin, thus closely resembling an ovarium formed of a single carpellum, (such as a follicle or legume,) spread open. In *C. revoluta* the leaf is in a less altered state, having at the extremity contracted pinnated divisions, (Pl. II, fig. 1,) but the part occupied by the ovula is, as in *C. circinalis*, the margin of the leaf. If, therefore, the *pistillum* be a modified leaf or carpellum, from the edges of which are produced the ovula, as is now admitted by the first structural botanists, the envelopes of the bodies which constitute the female organs in Cycadeæ and Coniferæ cannot be the calyx and ovarium, or indeed any thing else than the proper integuments of the seed; inasmuch as these bodies are produced upon the margins of the ovarium, the summit of which, if it were folded together, would become the style or stigma, and at the base, or surrounding which, would be found, perhaps, if in a state of sufficient development, the true floral envelopes. This argument receives additional force from the well known tendency of many leaves to produce upon their margins, either *buds*, (as in Bryophyllum and other plants,) which are in fact distinct individuals, or *ovula*, which are capable of becoming such by impregnation.

The species of Cycas more commonly examined by European botanists, appears to have been *C. circinalis*, which, with regard to the seed itself, seems to be in a less perfect state of development than the species now before us. Richard's admirable figures represent only the former species; and Professor Lindley's essential characters of the order, in his "Introduction to the Natural System," are obviously drawn, so far as relates to Cycas, from *C. circinalis*.* In the specimen of *C. revoluta* before us, the most important difference arises from the presence of a brown membranous coating of the nucleus, perfectly distinct during the latter part of the growth of the

* In the "essential character" of Cycadeæ, given by Professor Lindley, in his "Introduction to the Natural System," the "pistilliferous flowers" are described as "either collected in cones, or surrounding the central bud, in the form of contracted leaves, *without pinnæ*, bearing the ovula upon their margins." Such is really the case in *C. circinalis*, where the leaf is contracted into a flat scale. But in *C. revoluta*, only that portion of the modified leaf upon which the ovula are produced, is without the usual pinnated divisions. The same distinguished botanist likewise states the "*gyrate vernation*" of the leaves to be an essential characteristic of the whole order; while, so far as we have observed, such is actually the case only in *C. circinalis*, which in the beautifully gyrate disposition of its young leaflets, and also in the whole appearance of the growing plant, exhibits in the strongest manner the affinity of this order to the Ferns. The vernation is by no means gyrate in *C. revoluta*, nor in our American Zamia, or in such of the exotic species of that genus as we have had an opportunity to examine.

ovulum, and contracting no adhesion with it. (Fig. 3, *a*.) This we believe to be the *tercine*. From the apex of this coat, if the ovulum be dissected carefully, (even in a nearly matured state,) a minute columnar summit (fig. 3, *b*) is seen projecting upwards from the nucleus to the perforated apex of the inner membrane (secundine) of the ovulum. This is undoubtedly the point through which impregnation takes place, and as we can perceive no trace of the fungous substance* which in Richard's figures is represented as occupying a considerable portion of space between the nucleus and the inner integument, (the ovarium,) may we not infer that in this species it, in a state of greater development, appears under the form of the *tercine* or proper coating of the nucleus?

In the mature seeds of *C. revoluta*, the micropyle is distinctly visible upon the projecting point of the corneous inner integument of the seed. This projecting apex assumes, in the *young ovula*, somewhat the appearance of a dilated stigma, and the *primine*, or outer membrane surrounding it, also shows an opening, (the *exostome*, fig. 2, *a*,) which is the perforated style of the older authors. In the present specimen of *C. revoluta*, the exostome has disappeared entirely, as the seeds increased in size, and the true foramen of the ovulum has closed in such a manner as only to show the micropyle upon the apex of the inner integument, showing however a distinct trace of the foramen leading down to the minute process arising from the nucleus. (Fig. 3, *c*.)

As the seed approaches maturity, the outer integument, which is still covered, like the contracted leaf with which it is connected, by a dense woolly pubescence, becomes in its *inferior part* easily separable from the inner integument, which has now acquired a hard and corneous texture; this in *C. revoluta* is undoubtedly distinct from the outer soft covering, both together constituting the two genuine integuments of the seed. That these two integuments are not easily separable throughout, is no proof of their not being distinct.

It is evident, therefore, that the so-called female flowers and fruit in Cycadeæ and Coniferæ, are naked ovula and seeds, not only from their position upon an imperfectly formed ovarium, (the convolution of which not having taken place, the seeds are consequently left naked upon its face or margin,) but from their similarity to other plants

* Sir W. J. Hooker, (Bot. Mag. tab. 2827.) has remarked the absence of this fungous substance in the specimens of *C. circinalis* which he examined, and also the presence of the same "membranous lining" observed by us in *C. revoluta.*

in the structure of the seeds themselves, having the same integuments, the same foramina in the ovula and micropyle in the mature seed, with only such slight deviations in structure as might be expected from the peculiar economy of these orders.

In a paper read before the "British Association for the Advancement of Science," at the fourth meeting, held at Edinburgh in 1834, Mr. Brown has adduced a new point of analogy between Coniferæ and Cycadeæ, in the tendency which exists in both these orders to the production of a "*plurality of embryos*" in the same nucleus. Occasional examples of this plurality were not unknown in other plants, but it was only in Cycadeæ that any constancy in this particular had been observed. Mr. Brown's recent investigations, however, have demonstrated not only the general occurrence of this plurality of embryos in many Pines, but also that a *regular arrangement* of these embryos within the nucleus takes place with much uniformity in both these families.*

A resemblance in inflorescence, fructification, and seed, are not the only points of agreement between Cycadeæ and Coniferæ. The simple cylindrical stem of the former, which resembles outwardly the trunk of the Palms, (a monocotyledonous order,) has been shown by M. Brongniart to be decidedly exogenous in structure—probably only growing in the form of a simple trunk, in consequence of the non-development of the axillary buds. The leaves of both the Cycas and the Fir tribes, as Prof. Lindley remarks, have the same parallel arrangement of veins, and both tribes exhibit a marked similarity in the fewness of their spiral vessels. Cycadeæ and Coniferæ still farther agree in a character lately discovered, as unique as it is important, and which alone would establish the fact of a strong affinity existing between the two orders; namely, the singular perforations in, or rather globules adherent to, the fibres of their wood, to which there exists nothing analogous in the structure of any other tribe of plants.†

* Since writing this paper, a work has reached us, containing details of some remarkable experiments and investigations, made by Corda, on the impregnation of plants, conducted with that accuracy and minuteness so eminently characteristic of the Germans, which tends to elucidate this hitherto obscure portion of structural botany. Corda's experiments were made upon plants of the order Coniferæ, and the results are highly curious. Dr. Gray has lately read before the Lyceum of Natural History of New York a translation of Corda's memoir, which will probably soon be published. (See Vol. XXXI, p. 317.—Ed.)

† So permanent is this characteristic, that geologists have recently through it identified Coniferous wood, which has been imbedded in the coal strata for thou-

Placed thus as it were at the lowest step in the gradation of plants which have a vascular system and an exogenous structure, *Gymnospermæ* approach closely in their affinities to Flowerless Plants, through the Cycadeæ, which have mostly the same gyrate vernation as the Ferns, a manner of producing their seeds upon the margins of the leaves, analogous to the production of the thecæ in Osmundaceæ, and the same pinnated foliage and simple columnar trunks as some of the arborescent Ferns. They are also related to Equisetaceæ by a similar simplicity of structure in the female organs, if the sporules of that singular order are really naked ovula, as is very plausibly suggested by M. Ad. Brongniart. At least the resemblance of those organs to the female flower of Zamia, is in the highest degree obvious and striking.

But the relation between the Ferns and other flowerless plants, and Cycadeæ and Coniferæ, as well as the importance of these orders in former times, can only be properly appreciated by those who have paid attention to fossil botany, and are acquainted, by means of that interesting science, with the primitive flora of the globe. In those remote ages, when Ferns and marine Algæ, Equisetaceæ, and Lycopodiaceæ, with Cycadeæ, Coniferæ, and a few Palms, constituted the whole of the vegetable kingdom, these orders occupied a much more conspicuous station than at the present day. At that period, when, as geology has now incontestibly proved, the globe was tenanted by a "*race of reptiles*"—(those strangely formed animals, the aquatic and amphibious *Saurians*, which existed before the formation of the secondary strata,)—the vegetation of the earth was also in a corresponding primitive state of organization. Cellulares or flowerless plants, covered the greater portion of the globe; among which were Equisetaceæ of enormous size, herbaceous and arborescent Ferns, the latter of extraordinary altitude, and Lycopodiaceæ, an order now dwindled down to a few diminutive, moss-like plants, but which, it is thought by Brongniart, reached at that time the stature of our tallest forest trees. Associated with these, are found the first Coniferæ and Cycadeæ, which compose a very considerable proportion of the flora of those remote ages, being probably the next advance in the ascending scale of vegetable structure.

---

sands of years! Messrs. Nicol and Witham, by grinding down to very thin plates sections of fossil woods, have been able to call in the microscope to their aid, and have ascertained their structure in the most satisfactory manner. Their examinations have led them to the conclusion, that all known exogenous fossil woods belong either to Coniferæ or Cycadeæ.

In the Ferns and other flowerless plants, we find the reproductive organs either obscure or imperfect; and in the next succeeding step, (the Coniferæ and Cycadeæ,) those organs, though distinctly characterized, are still formed in the most simple manner and accompanied with a corresponding simplicity in the structure of the wood, the leaves, and the whole vegetable system. As also we perceive the remains of the carnivorous and lacustrine *mammalia* succeeding in a later formation to those of the more primitive animals, so we find the Palms, some of the Liliaceæ, and many dicotyledonous plants, gradually assuming their respective places, just as the improving condition of the globe became more fitted to their respective organizations. In this way the *history of the earth* is unfolded to us; and such are the proofs perpetuated and unchanged through centuries of time, which show that it is through successive ages, and by a slow and gradual series of changes that the globe has acquired its present more perfect state; and that both departments of organized matter have advanced with equal steps and mutually dependent relations to that condition (perhaps still progressive,) in which they are found at the present moment.

EXPLANATION OF THE PLATES.

Pl. I, *Cycas revoluta*, with the crown of contracted leaves in the centre bearing the nearly mature seeds.

Pl. II, Fig. 1, the contracted leaf or imperfect ovarium, with the full grown ovules upon the margin of its lower half. Fig. 2, the young ovulum or female flower: *a*, *exostome*, or opening in the outer membrane, (primine.) *b*, the dilated apex of the *secundine* or inner membrane, through which the foramen leads to the nucleus. Fig. 3, the full grown seed: *e*, outer integument of a soft texture: *d*, inner integument, hard and bony. *a*, tercine, or third coat enveloping the nucleus (*f*): *b*, minute columnar process connecting the nucleus with the foramen *c*.

Fig. 4, impregnated nucleus. *a*, embryo. *b*, albumen. All of the size of nature.

Note,—It is proper to observe, that in the specimen of *C. revoluta* here figured, the ovula (there being no male flowers in bloom at the same time,) have not been impregnated. This perhaps renders it still more interesting; for while the ovula have gone on gradually acquiring color and consistency, as is the case when impregnated, there has of course been no embryo produced in the nucleus, which has the usual homogeneous appearance, with a trifling cavity in many of the matured specimens, where the embryo should have been found. It presents therefore a strong point of interest, in the fact that the coats of the seeds being here quite perfect and distinguishable, are of course proved, contrary to the opinion of some carpologists, *not* to be the *product* of fecundation. In Pl. II, Fig. 4, the embryo *a* is shown as figured by Richard and others.

The drawings in both plates were executed from a noble specimen in the exotic collection of J. W. Knevels, Esq., Newburgh, N. Y., which also contains several other fine specimens of Cycadeæ. This plant, probably about thirty years old, has flowered this season for the second time. The trunk is about four feet in height, the crown of foliage about eight feet in diameter, and the tuft of contracted leaves in the center eighteen inches in diameter.

Art. V.—*On the Economical Uses of some species of Testacea.*

The study of natural history in this country is evidently progressing; cabinets are formed, and a lively interest is taken in the subject, where not long since it was entirely neglected; and the day is nearly past when specimens are collected merely for their beauty, and preserved solely as ornaments. A scientific interest is now more or less attached to all such objects, and we believe that an earnest desire to study nature as she exists in the woods, in the air, and in the waters, is daily gaining ground. It is when the science is thus applied, and only then, that natural history is fully useful or interesting; and the more it is so studied, the sooner we reach the truth, and the greater is the pleasure.

The causes of this progress are many and obvious; but we cannot help thinking that the beautiful plates and the enthusiastic writings of Wilson, Bonaparte, and Audubon, as well as the valuable public museums, in most of our large cities, have done much to promote and force it on.* They have, as it were, forcibly turned the attention of the public to the subject, and laid open to them the stores of happiness and pleasure contained in such pursuits; by intimately mixing in their amusements they have torn from the face of science the mask of mystery and difficulty with which it was (and perhaps, in some parts, still is) unfortunately shrouded; and by making it familiar, have caused it to be admired and cultivated. But notwithstanding this, natural science has not yet been sufficiently brought home to the every day feelings and occupations of men. It is still looked upon as a thing apart, not as a thing connected with our education, with our pleasures, or our luxuries; and the knowledge of it, instead of being an assistance in our business, is considered by too many as only an hindrance to it. Professional writers on the subject have perhaps rather nourished, than helped to dissipate this prejudice: absorbed in the technical and more scientific parts of the subject, they have neglected to show its connection with the arts, and they have either overlooked entirely, or kept in the back ground the application of this knowledge. Natural history is a true science—as are all its

---

* It may be necessary to explain to foreigners, that these museums, besides being open daily to visitors, on payment of a small sum, are generally used as exhibition rooms for ventriloquists, jugglers, fat men, *et hoc genus omne.*

branches; and as such they are the parents and fosterers of the arts. What do not the miner and the landowner owe the geologist?—the agriculturist to the zoologist and botanist?—and every one to mineralogy? and yet how seldom is it that we view these pursuits in this light. Were this connection more frequently reflected on, and the useful results of science more generally brought to notice, we are convinced that many who now neglect it would study it, as conducing to their own progress, as well as to that of their country, in practical knowledge; and those who now idly despise it, would become its warm and active advocates.

As far as regards the cultivation of our minds, the utility of the science cannot be denied. It is from the contemplation of the works of the Creator, that the highest and most glorious thoughts of his majesty and beneficence are drawn; it is from the observation of them that we form our ideas of beauty, of elegance, or of grace; and in them we find a never-ceasing source of admiration, amusement, and instruction. This study enlarges the mind, in a peculiar manner softens the heart, and above all, prompts to a continued dependence on Him who "provideth the raven with his food," and decks the lily with more beauty than even Solomon in all his glory was possessed of.

"No man," remarks the great Bacon, "need say that learning will expulse business, but rather it will keep and defend the possession of the mind against idleness and pleasure, which otherwise may at unawares enter in to the prejudice of both." The greatest and best in all ages have been celebrated for their knowledge of and love for natural history. To mention but a few—Solomon, we are told, wrote a work on the subject: "of trees, from the cedar tree that is in Lebanon, even unto the hyssop that springeth out of the wall.... of beasts and of fowl, and of creeping things, and of fishes;" Aristotle, the deepest and most able ethical philosopher that perhaps ever existed, has left us a large and most learned work on the same; to Sir Isaac Newton, the christian is not less indebted than the philosopher; and in still more modern times, Cuvier is scarcely more celebrated for his researches into, and classification of nature, than for his political acme, general learning, and piety. But perhaps in no branch of natural history has this connection been more neglected than in Conchology; the generality of our shells are comparatively so minute, and their uses so seldom obvious to us, that with a very few exceptions, writers have altogether forgotten to mention the purposes for which society in general is interested in them; and yet on examining into this subject, we are surprised to find how much we owe to shells, for our luxuries, our pleasures, and our tables; and not only are we, but the ancients were eminently their debtors. The object of this article is to trace and elucidate those uses, and to show, in connection with their natural history, in what manner shell-fish either of old were, or, in the present day are, turned to profit. Had the writer been acquainted with any work in which this had been done, he probably would not have attempted it now; but in seeking information on the subject, he was surprised to find how meagre and contradictory were the statements in most of the Encyclopœdias, and works of general reference. In the ancient prose writers and poets, in books of history and commerce, in travels and scientific journals, he has found much information, but scattered far and wide, and not likely to be sought after by those who are but little interested in the subject, or unacquainted with the science. This he has endeavored to compress, as far as was possible with a regard to clearness, and by carefully giving the references, he has put it into the power of all to look to the original sources if they desire further information.

Of all the departments of natural history, Conchology appears to be here the most popular: owing to the maritime connections of this country with all parts of the world, but especially with India and the South Seas, opportunities of procuring specimens are enjoyed, scarcely surpassed elsewhere. And although our marine shells are neither numerous nor generally beautiful, yet those of our rivers are peculiarly interesting, and they are those to which we have most general access. Besides, a collection of shells has advantages over that of any other department; they are always beautiful, they take up but little space, and require no art to preserve them, while by the Linnean arrangement, a knowledge sufficient for amusement is easily acquired. But notwithstanding they are in general such favorites, little attention seems to have been paid to their economical uses, and still less, if any, to the improving or becoming possessed of the advantages foreign countries enjoy from them. While our fields and farm yards are stocked with plants and animals from every part of the world, we have not one shell which has been intentionally introduced for use. In England we are only aware of one attempt to naturalize marine shells, and how that has succeeded we know not; but were proper means used, there is little doubt that many of them would be successful. There, as here, they have animals, and birds, and plants from every part of the world—from the most contrary climates, and yet all thriving. The quail and the turkey from this country, the guinea-fowl from the burning plains of Africa, the peacock from Asia, and still more lately the kangaroo and emeu from New South Wales;* and what is to prevent shells living and breeding in an element by far less subject to change in temperature than the air. The *Ostreæ* and *Pectines* in particular might, we feel sure, be successfully transplanted, if proper care were taken.†

To guess at the causes why this has not been done, were futile; but we may suggest, that it is perhaps owing to the very general ignorance on the subject, the employment of fishermen being inferior and ill paid, and the variations of the ocean throwing difficulties in the way greater than in the introduction of animals and birds on land. The descriptions of the shells have not been arranged systematically: but they stand according to their general interest, or their artificial connection one with another. It has also been thought best to omit all scientific descriptions, as most of the species are well known, and are to be met with in all books on Conchology.

The Linnean nomenclature has, with a few exceptions, been followed.

I. Mytilus margaritiferus, (Linn.)—*The Pearl Oyster.*

Of all the Testacea, this species is the most valuable, the best known, and enters the most largely into the arts. It not only pro-

---

* The following are the foreign animals domesticated in England. The original habitats (with the exception of the two last) are given on the authority of Jenyns, in his Manual of British vertebrate-animals. From Europe, *Cervus Dama*, *Perdix rubra*, *Cygnus Olor*, *Cyprinus Carpio*, *Esox Lucius* (?) From Asia, *Mus decumanus*, *Equus Caballus*, *E. Asinus*, *Phasianus Colchis*. From Africa, *Mustela Furo*, *Felis maniculata*, *Numida Meleagris*, *Anas Ægypticus*, *Cygnus Guineensis*. From North America, *Meleagris Gallapavo*, *Perdix Virginiana*, *Cygnus Canadensis*. From South America, *Cavia Cobaya*. From India, *Pavo cristatus*, *Gallus domesticus*, *G. lanatus*, *&c.* From China, *Phasianus torquatus*, *Cyprinus auratus*. From Australia, *Halmaturus giganteus*, (Ill.) *Rhea Novæ-Hollandiæ*.

† In Loudon's Magazine of Natural History, Vol. IX. pp. 572—574, mention is made of two shells which have naturalized themselves in Great Britain. The one is the *Mytilus polymorphus*, (Pallas,) supposed to have been introduced into the Thames on timber, and now spread through England and Scotland. The other is the *Mytilus crenatus*, (Linn.) which must have been brought from Bombay on the bottom of a ship, and has now firmly established itself, in company with the *M. edulis*, in Portsmouth harbor.

duces a beautiful and expensive luxury, but the shell is used in the manufacture of various useful and ornamental articles, while the animal serves as food for the inhabitants of those countries where it is most generally found; and although pearls are produced by many other bivalves, yet from their inferiority in color and size, this is the only species which can now be said to be of any real importance for this purpose. Anciently European pearls were extensively used, though never considered equal to the oriental; but as the trade between foreign countries has increased, so has the value of the former gradually diminished, and they are now seldom sought for, and of little comparative worth.

Ancient history.—During the earliest periods of which we have authentic history, the oriental pearl appears to have been known and appreciated; Job, who is supposed to have lived about B. C. 1520, speaks of it as being in his time of high value, and much esteemed.* Solomon frequently refers to them;† and Jeremiah,‡ speaking of the Nazarites of Jerusalem, makes use of a beautiful simile in describing them as more ruddy than pearls. In the New Testament, we frequently meet with them, as inferring great riches and splendor.‖

In Rome pearls were extensively used, and of great value. Pliny tells us that in his time the ladies were not content with using them as ear drops and rings, but had them embroidered on their dresses and their sandals; they were not satisfied with solely wearing them, but must walk on them, and among them. They were obtained from the Red Sea, or brought to Rome by the Arabian merchants, from the Indian Ocean. They were the most numerous on the coast of Taprobane, (now Ceylon,) and Toïdis, and round the promontory and city of Perimula; but those from the western

---

* Job, xxviii. 18. Dr. Hales supposes that Job lived at a much earlier period, and dates his trial, of which we have the account, B. C. 2130. He also appears to have lived in the land of Idumea, and if so, may very naturally have been acquainted with the pearls of the Persian Gulf.

† Proverbs, iii. 15, viii. 11, xx. 15, xxxi. 10.

‡ Lamentations, iv. 7. The Hebrew word is *Penemin*, and occurs only in the above cited passages. The Septuagint and the Vulgate translate it as "things hid, precious stones, or ivory." Our English version, with the one exception in Job, always renders it "ruby." David, in his Psalms, makes no mention of it, and as we do not hear of it till the time of Solomon, when riches from all parts of the world were collected at Jerusalem, we may infer that previously, the Israelites were not acquainted with it.—See *Calmet's Dic. of Holy Bible*, Art. PEARL.

‖ Matthew, xiii. 45. Revelations, xxi. 21, &c. &c.

shores of Arabia, the Persian Gulf,* and the Red Sea were the most perfect and the most celebrated. The mode of capturing them seems to have varied little from that practised at the present day. Divers were employed, who brought them to the surface in nets, and they were packed in jars with salt till the animal was decayed. On being taken out, the pearls were found at the bottom of the jars.† Among the ancient philosophers, effects were continually attributed to causes the most inconsistent and the most contrary to nature—in fact, merely wild or fanciful guesses. Many were of course made as to the origin of these substances. The general opinion appears to have been, that they were formed by drops of dew falling into the shell, for which purpose it periodically rose to the surface ; and Pliny gravely informs us that if the atmosphere was thick at the time, they were dark and clouded ; if it was clear, they were white and brilliant. It is singular that the same opinion is found to prevail at the present day among the natives of Ceylon, and very similar to it, is the account of their formation recorded in one of the Sanscrit books of the Brahmins.‡ The same fancy also exists in the interior of Hindoostan.‖

The nacre was manufactured into boxes for the preservation of sweet perfumes and precious ointments.

Of the pearls of ancient times, those belonging to Cleopatra are certainly the most celebrated, and though there is reason for believing that the account of her dissolving one of them in vinegar and drinking it to Antony's health at supper is an historical fiction, yet that a pearl or pearls of great value were in her possession is pretty certain. In Pliny's time, the two halves of a magnificent pearl, said to have been the fellow to the one destroyed, were hung in the ears of the statue of Venus Genetrix in the Pantheon. This author estimates the value of it at a sum equal to $375,000. Other persons are also reported to have dissolved pearls and treated their guests to the same expensive draught. Julius Cæsar gave £48,437 for one, which he presented to one of his mistresses.§

There was so much difficulty in obtaining pearls of exactly the same size and color, that the Roman ladies, about the time of the

---

* As early as B. C. 311, the Persian Gulf was famous for them.—Macpherson's Annals of Commerce, I. 83.

† Plin. Hist. Nat. lib. IX. cap. 35.

‡ Asiatic Researches, V. 410, Lond. ed.

‖ Forbes' Oriental Memoirs, II. 235.

§ Macpherson's Annals of Commerce, I. 144.

Jugurthan war, gave them the name of *Uniones*, which appears to have been the first occasion on which this word, now so well known, was applied to shells.*

The derivation of the Greek word μαργαρον or μαργαριτης, from which the other countries of the south of Europe have derived theirs, is supposed to be from the Tartar *margion*, signifying a globe of fire, and the Persian *marvarid*, meaning offspring of light.† In the present day, the Arabians, Persians and Turks use the word *merovorid*, for this gem.‡

In Rome they were entailed and handed down to posterity, and if sold, a warrantry of their identity required.

Modern history.—The pearls and shells used at the present day are chiefly brought from the island of Ceylon, where the fisheries are extensively prosecuted, but other parts of the eastern as well as the western hemisphere are celebrated for producing them. In India the chief places are the island of Bahren or Beharein in the Persian Gulf,§ Catesa on the coast of Arabia Felix, and near the city of Nipehoa, on the lake of the same name in Chinese Tartary, as well as in the Red Sea, and on the coast of Japan. A few also are procured near Java and Sumatra. Pearls are brought in great numbers from the Persian Gulf to Bombay,|| but those sold at Madras, and which are found in the Gulf of Manaar, are more highly esteemed in Europe than those procured in this place.¶

The best shells of commerce are from the Sooloo Islands, situated between Borneo and the Philippines, the shores of which afford the finest and largest shells hitherto discovered. There is also a fishery at Tuticoveen, on the coast of Coromandel, which is held as a monopoly by the British East India Company. They are also found off Algiers, in the Mediterranean; in 1826, this fishery was farmed by an English company, but with what success is not known.** They also inhabit the islands of the South Seas, especially on the

* Plin. Hist. Nat. IX. 35.

† Rees' Cyclopœdia, Art. PEARL.

‡ Calmet's Dictionary of the Holy Bible, Art. PEARL.

§ "We can hardly consider any of the fisheries on the Persian Gulf as belonging to Persia, for although the monarchs of this nation have always claimed the sovereignty of the sea, they have at no period had a navy that could enable them to contend with the Arabic rulers of the opposite coast."—Sir J. Malcolm's History of Persia, II. 515.

|| Heber's Narrative, II. 165. *Am. Ed.*

¶ Kelly's Univ. Cambist. I. 95, note.

** McCulloch's Commercial Dictionary, Art. PEARL.

coasts of the Paumotu Islands, to which places vessels are sent from New South Wales, and prosecute the fisheries to some extent.*

In the Atlantic Ocean, they are chiefly fished for on the coast of Terra Firma, in the Gulf of Mexico, near the island of Cubagna, and on the Margarita or Pearl Islands. The River de la Hache abounds with them.†

In the Pacific, they are plentiful on the island of Gorgona, and generally along the coast of the Bay of Panama, and being found in shallow water are easily obtained.‡ In the ocean around California, and in the adjacent islands, they are also found in great abundance.§ The oriental pearls are however by far the finest, surpassing the occidental specimens in color, clearness and size.

In the time of Marco Polo, (1295,) Bagdat, on the Tigris, was the great mart of the world for pearls, and all Europe was supplied from thence.||

In 1506, the Spaniards carried on a large pearl fishery in the West Indies. About the same time adventurers flocked to California from all parts, to enrich themselves with these jewels, and in the beginning of the 18th century, numbers from all the western ports of Spanish America, congregated there for the same purpose.

Natural history.—The shell of the young of this species is comparatively smooth, but as they grow older it becomes more scaly, rough and unequal. When full grown, it is sometimes ten or twelve inches long, and the length rather exceeds the breadth. These are thick and ponderous, but the young shells are brittle and slightly eared.¶ It is in the former that pearls are chiefly found, the young ones being either entirely without them, or having them very small and inferior; and the practised fisherman can generally judge in which he will find the largest and most valuable.** They lie in banks or beds, generally near coasts, and in water from three to fifteen fathoms, and like the other members of the genus, adhere to the rocks and to each other, by the Byssus. The older shells lie separately, while the young are attached to the surface of their par-

* Ellis' Polynesian Researches, Vol. II, pp. 133, 207.
† Chalmers' Universal Dictionary, Art. PEARL.
‡ Burney's Chron. Hist. of Discoveries, IV. 168.
§ Natural and Civil History of California, I. 49.
|| Macpherson's Annals of Commerce, I. 456.
¶ Dillwyn's Descr. Catal. of Shells, I. 302.
** Asiatic Researches, V. 393—411.

ents. The Byssus is of a dark green color and metallic hue, and they can move slightly by contracting or extending the muscle to which it is attached. The ancients supposed them to be endowed with peculiar powers of locomotion, describing them as grazing at the bottom of the ocean, with a leader to direct them, &c.* but whether they have any such power is extremely doubtful, at least after attaining the thick shell.† The sexual differences have not hitherto been discovered, although the natives of Ceylon pretend to distinguish the sexes, by the appearance of the shell. Those that are large and flat, they call males; those that are thick, concave and vaulted, they call females; but Mr. Le Beck, who appears to have carefully examined and dissected this animal, declares he was unable to discover any difference.‡

Like the *Ostrea edulis,* this fish appears to thrive best in a mixture of fresh and salt water. Pearls are always the most beautiful in those places of the sea where a quantity of fresh water falls, as at the mouth of rivers and streams,¶ while those produced by the shells growing on rocky bottoms, are found to be of a better water than those that lie among sand and coral.

Of the many suppositions as to the cause of pearls, that of Raumeur is the most probable, and in the present day generally adopted. He supposed them to be owing to a disease in the fish, as calculi in mammalia, and to arise from a ruptured or morbid state of the vessels provided for the secretion of the materials of the shell: most experiments and observations go to prove the truth of it.||

---

* Pliny, IX. 35.

† Mr. Montgomery Martyn makes the following remarks on this shell, but from his very obvious ignorance of natural history, and the general inaccuracy and haste of his observations in this department, they are very little to be relied on. We however give them, as from a modern and widely circulated work, and not entirely without its merits, although abounding in faults. "At certain seasons, the young oysters are seen floating in masses, and are carried by the currents round the coasts (of Ceylon.) They afterwards settle and attach themselves by a fibre or beard on coral rocks, and on sand; they adhere together in clusters; when full grown, they again separate, and become locomotive. The pearls enlarge during six years, and the oyster is supposed to die after seven years."—Martyn's History of the British Colonies, 2d ed. I. 522, note.

‡ Asiatic Researches, *ut supra.* Dr. Kirtland remarks the same with respect to those species of the family of *Naïades* of Lamarck, which are found in the waters of this country, and he is "persuaded that each sex possesses a peculiar organization of body, associated with a corresponding form of the shell, sufficiently well marked to distinguish it from the other."—Silliman's American Journal, Vol. XXVI, pp. 118, 119.

¶ Bruce's Travels to discover the Sources of the Nile, VII. 322.

|| Transactions of the French Academy.

They are found in the body of the animal, and not confined to any particular part. Some contain but one, some a multitude of small specimens, known by the name of *seed pearls*, while in the shell itself, and protruding above the surface, are frequently circular nodules resembling them; as these must be cut, and on one side are flat, they can only be used for setting, and of course are of less value. They are technically termed by jewellers the *wens of pearls.*

There is a common opinion that the animal may be forced to produce the gems by artificial means. The inhabitants of the shores of the Red Sea were said to have wounded them, and returned them to the water; and the Chinese we are told insert beads of the nacre into the shell, to be covered by the animal with the perlaceous substance.* But these accounts from many obvious reasons are improbable, and we have not been able to meet in modern histories with any authenticated instance of its having been done. In river shells it might be more easily effected; and we shall have to refer to it again under the description of *Mya margaritifera.* They sometimes grow so large as to hinder the shell from shutting; in which case the fish dies,† and they are comparatively not uncommon of the size of a small bullet.

On analyzation, perlaceous shells appear to be formed of animal matter, applied stratum upon stratum, with carbonate of lime be-

---

* See Rees' Cyclopœdia; Encyclopœdia Americana, &c. &c. Art. PEARL.

Beekman, in his History of Inventions, vol. ii. page 5, third Lond. Ed., seems to have been the first in more modern times to have given extended publicity to this opinion. He quotes as his authority a German work, and adds, that "the truth of this information cannot be doubted." That it *might* happen, we do not mean to deny, but sufficient authority is wanting to prove it, and many powerful reasons are against it. How and when does the reader suppose the pearls were inserted? on a string containing five beads; and the clever Chinese caught the shell when it rose to the surface in the spring to enjoy itself! Of course next year it had to be caught again to get at them, but how we are not informed. He has however been servilely copied by most subsequent writers on this subject, with the exception that he expressly says the shells are fluviatile, while his copyists confuse them with, or describe them as the present marine species. Beekman confesses that some experiments of the kind, made in Bohemia, were without success. Postlethwaite gives an account in some respects similar, but still less creditable, from a Chinese work. The pearl was made of several materials; among others, nacre and bruised pearls, and the shell was kept in a basin, to be daily fed on medicinal and gummy roots. He himself allows that it does not appear probable. (See Postlethwaite's Dictionary, vol. ii. Art. *Pearl.*) It is time however that such fables were exploded, and left out of works professedly scientific, and bearing on the title page the name of some learned editor, assisted, as we are told, by "eminent professional gentlemen."

† Chalmers' Universal Dictionary, Art. PEARL.

tween them; each membrane has a corresponding coat or crust of carbonate of lime, secured by a new membrane; and each coat of lime is so situated that it is always between every two membranes, beginning with the epidermis, and ending with the last formed internal one. The animals which inhabit these stratified shells, increase their habitation by means of a stratum of carbonate of lime secured by a new membrane, and as every additional stratum exceeds in extent that which was previously formed, the shell becomes stronger in proportion as it is enlarged; and the growth and age of the animal may be denoted by the number of strata, which concur to form the shell. Pearls prove also to be similar in composition to the nacre, and they appear to be formed of concentric coats of membrane and carbonate of lime. The wavy appearance and iridescence of mother of pearl, and of the pearl itself, are evidently the effect of the lamellated structure and semi-transparency. On dissolving the lime by acid, the animal frame-work of the shell is left exposed.*

Fisheries.—In the older writers, the following mode of catching this fish is given, and though it differs in some respects from the latest accounts, yet the difference may probably be owing to the lapse of time, or from being practiced at different places. It however refers to the island of Ceylon, though we are not told the exact part.

There were two seasons when the shells were particularly sought after, during March and April, August and September. The vessels used were of two sizes, the larger carrying two divers, the smaller only one. In the morning they set sail for the banks, with the land breeze, which at these seasons blows regularly, and on arriving there anchored. The diver bound a stone to his body about six inches thick and one foot long to enable him to walk against the water, and another of from twenty to thirty pounds weight to his foot in order to sink him; around his neck was a net to hold what he collected, and he was provided with strong gloves or a short iron rake, to tear the shells from the rocks.† His ears and nostrils were filled with cotton, and a sponge dipped in oil was fastened to his arm that he might occasionally breathe without inhaling water.‡ Round his waist was

---

* Philosophical Transactions of the Royal Society of London, xviii. 554. Abrid. Ed. 1807.

† Chalmers' Dictionary, Art. PEARL.

‡ Encyclopœdia Americana, Art. PEARL. "According to the depth of the water, the seal takes into its stomach a quantity of pebbles, as ballast, as it were, being obliged to sink itself. To enable it to dive so admirably, it collects a quan-

a cord to pull him up again when he grew tired. Thus equipped, he leaped overboard, and collected as many shells as he could while he remained under water. We are told they sometimes remained below fifteen to twenty minutes, but this seems a very gross exaggeration, from two to seven minutes being the general period in the present day; they repeated this while they stayed as often as they could. In the evening the boats returned with the sea breeze, which then blows on land. On the beach the fishers dug pits four or five feet square, and throwing in the oysters, raised heaps of sand over them to the height of a man, so that at a distance they looked like an army ranged in order of battle. When the animal was decayed, these were opened, and the sand passed through sieves, to collect the shells. These again were passed through nine sieves, to assort the qualities, and the smallest sold as seed pearls.

The manner of catching them in the West Indies differs very little from this mode. The employment is considered very unhealthy, and the divers are continually in danger from sharks. Among the Colchi, during the first century of the Christian era, so dangerous was this business considered, that condemned criminals were entirely and solely employed in it.*

Since the British have held possession of the island of Ceylon, the pearl fishery has been a monopoly in the hands of government. It is now a more important business, and carried on with greater skill and tact. About twelve miles from Manaar, and in the gulf so called, lies the bay of Condotchy, on which is a small town of the same name. Off here the fishing banks lie, and extend several miles along the coast from Manaar Sound to Arippo. The principal one is about twenty miles out to sea. At this town, scarcely inhabited except during the fishing time, all the boats collect in the beginning of the season; few of them belong to the island, and most of them are brought annually from the coast of Coromandel and Malabar. The fishing is confined to one season, and begins generally about the second week in February. The first thing that is then done is to sell by auction to the highest bidder the right of fishing for the season, and he either catches all himself, hiring the boats, or lets out the privilege to others. The fishing seldom continues above thirty entire days, for

---

tity of blood on the right side, *the same as is found to be the case with those persons employed in diving for pearls.*"—Dr. Riley, at the meeting of the British Association at Bristol, 1836, reported in the Literary Gazette, September 3d.

* McPherson, I. 172.

though it may be carried on till the 15th of April, yet owing to holydays, storms, and other causes, they seldom work more than this time in the two months. It is found necessary to leave the banks from four to seven years to recruit, so that parts only are annually disturbed. Each boat carries twenty one men, ten of whom are divers, and one the *Sandel* or head boatman. At ten o'clock at night, on a signal, the boats leave Condotchy together, with the land breeze, and reach the banks about day light. They immediately begin diving, and continue till the sea breeze sets in. The divers are very expert, and go down by fives, so that there is always one half resting. They require no assistance, except a stone to their feet, a net and a rope. From their earliest infancy they are accustomed to the exercise, and fearlessly descend to the bottom at a depth of from five to ten fathoms, in search of the treasure. The time they generally stay below is about two minutes, but some have been known to exceed seven. To continue longer than this is supposed to be impossible. On coming up they generally discharge water from the nose and mouth, and occasionally blood. The cargo of one boat may amount to thirty thousand oysters, if the divers have been industrious and successful.

On landing them, some merely throw them on mats to rot in the open air; others bury them in enclosed pits about two feet deep, till the animal has dried up. For sorting them they make use of brass plates, perforated with holes of different sizes. The piercing is accomplished by an instrument peculiar to the natives, and which they use with much ingenuity. It is a conical piece of soft wood, on legs, with pits for the larger pearls. The smaller ones are beaten in with a wooden mallet. The drilling instruments are iron spindles of various sizes, and are turned round in a wooden head by means of a bow, while the pearl is occasionally moistened with a little water.*

In the Persian Gulf there are two seasons, but shells are fished for chiefly in July, August and September. The divers use a piece of horn to compress their nostrils, and bees' wax to stop their ears.†

In California, the banks (which are there called ***Hostias,***) lie in three or four fathoms of water, and the fishery is carried on by divers, but owing to the little depth at which they are found, with neither labor nor difficulty.‡ The fishery at Colombo, in Ceylon, was at

* Asiatic Researches, *ut supra.*

† McCulloch, Art. Pearl.

‡ History of California, I. 49.

one time very productive, but some years ago it entirely failed; and though it has been lately (1825) resumed, the success has been small.* These sudden failures occasionally occur in most banks,† but we have not met with any satisfactory explanation of the cause. In the Red Sea this species holds the first rank among pearls, and is called the *Lulu el Berber*—i. e. the pearl of Berber, or Beja, the country of the shepherds.‡

Uses.—Besides the pearls, the shell and fish are both used. The former in the manufacture of knives—for inlaying, in the constructing of ornaments, &c.; and the latter as food. The nacre is generally separated from the external part by the lapidary's mill or aqua fortis, and cut up by instruments made expressly for the purpose.§ The inlaying of mother of pearl has been brought to high perfection at Jerusalem; great quantities of the shell are carried daily from the Red Sea to that place, and of these, all the fine works—the crucifixes, the wafer boxes, and the beads are made, which are sent to the catholic countries of South America.¶ We may suppose the Romans were ignorant of this art, as Pliny makes no mention of it. The fish is eaten by the lower classes of the Singhalese, either fresh in their curries, or cured by drying. In this latter state they are carried to the coast of Hindoostan and disposed of there.|| In the Island of Gorgona also, they are used by the Indians and Spaniards, and hung on strings to dry. If eaten raw they taste coppery; but when boiled are considered good.** The aborigines of California were ignorant of the use of the pearl, but they used the fish, throwing it on the fire to get at it and cook it.†† It is said also, that on the discovery of Mexico, the Spaniards found these gems in use and esteemed by the Indians, but that from the same manner of killing the animal their color and lustre were destroyed. In the Society Islands, the Indians manufacture their fish-hooks out of this shell, the glitter of which serves instead of bait.‡‡

---

* Heber, II. 165.

† Dictionnaire Universelle de la Geographie, par J. Peuchet, Art. Ceylon.

‡ Bruce, VII. 323.

§ Ency. Ameri. Art. Nacre.

¶ Bruce, VII. 322.

|| Asiatic Researches, *ut supra.*

** Burney, IV. 168.

†† Hist. California, I. 49.

‡‡ Ellis' Polynesian Researches, I. 146.

Besides being used as an ornament, pearls were formerly in high estimation as a medicine, and given in cordial potions; but as they differ in no respect from any other calcareous earth, they have been long neglected, and are now, we believe, never administered.* The ladies, however, still use a cosmetic under the name of pearl powder, but which is, notwithstanding, understood to be metallic.

The most remarkable pearls of modern times are, one which was in the possession of Philip II, in 1574, as large as a pigeon's egg; one mentioned by Tavernier in the hands of the Emperor of Persia in 1633, and which was purchased of an Arab for the extraordinary sum of £110,400; and that of the Emperor Rudolph, mentioned by Boetius, called *La Peregrina*, of the shape of a pear, weighing thirty carats.† In Europe, in common with all jewels, they are sold by the carat. In Asia, the weight differs in different states. At Bombay and Madras pearls are valued by two kinds of weights, real and nominal; by the former they are weighed, by the latter sold.‡ In the former country, pearls of a "white water" are most sought after, but the Indians and Arabs prefer those of a "yellow water."||

Artificial pearls, of which the Romans appear to have been ignorant, are made of thin glass beads lined with the scales of, or a white powder from the belly of the Bleak, (*Cyprinus Alburnus*, Linn.) and filled with wax. To obtain a pound of scales, four thousand fish are necessary, and these do not produce four ounces of the *essence d'orient*, as the perlaceous substance is termed. At St. John de Maizel in the Challonnois is a manufactory in which ten thousand pearls are made daily.¶ From the facility and accuracy with which these are manufactured, the price of the real article in modern times has much declined. A handsome necklace of Ceylon pearls smaller than a pea, costs from seven hundred and fifty to thirteen hundred and fifty dollars; but one of pearls about the size of peppercorns may be had for about sixty five dollars; the pearls in the former selling at five dollars each; those of the latter at thirty seven cents.

The importation of mother of pearl shells in England in 1832, amounted to seven hundred twenty one thousand five hundred and twenty seven pounds weight.**

---

* Hooper's Med. Dic. Art. Margarita. † Chalmers, Art. Pearl.

‡ Kelly's Univ. Cambist. Vol. I. pp. 92, 95.

|| Rees' Cyclopœdia, Art. Pearl.

¶ Beekman, II. 16. ** McCulloch, Art. Pearl.

II. Mya margaritifera, (Linn.)—*The Horse Muscle.*

Next to the last species, this shell is the most celebrated for its pearls, and which in old times not unfrequently came into competition with those from India. Julius Cæsar is said to have been stimulated to the invasion of Britain by the sight of the pearls brought from it;* and he certainly on his return to Rome presented a breastplate made of them to the Temple of Venus Genetrix.† They appear to have been at that time, A. D. 14, an object of commerce to Gaul, if not further south.‡ Forty years later they were common in Rome. Pliny informs us they were used in his time, and though of inferior worth, were often so large and beautiful as to be of considerable value. In general, however, they were small, dim, and wanting in lustre.

About the year 1120, the Scotch pearls were in great request. King Alexander I. is said to have exceeded all men in that species of riches, and his pearls, on account of their large size and superior brightness were celebrated and coveted in distant countries.§ In 1355, they were still an article of exportation. They were esteemed in France, but not equally with those of India, as appears by the MS. statutes of the Goldsmiths' Company at Paris, where it is ordained that no worker in gold or silver shall set any Scottish pearls among the oriental ones, except in large jewelry for churches,|| for which, probably, a sufficient quantity of the oriental pearls could not be obtained, or were too expensive.

Among the articles exported to Antwerp from Scotland in 1560, and enumerated by *Guicciardin*, we find "fine large pearls" mentioned.¶ In 1665, they were still sought for and worn in England, and a writer in the Philosophical Transactions of London at that time, makes mention of one found in Ireland which weighed fifty six carats, and was valued at £40, and of another for which £80 had been refused, besides "a vast number of fair, merchantable pearls, too good for the apothecary," offered for sale by persons from the same place.** About 1760, the wearing of real pearls coming more into fashion, those of Scotland, which had previously been almost

---

* Sueton. Vit. Jul. Cæs. cap. lxiv.

† Plin. Hist. Nat. lib. ix. 35.

‡ Macpherson, I. 133.

§ Macpherson, I. 318.

|| Ibid, I. 555.

¶ Macpherson, II. 131.

** Phil. Trans. of the Royal Society, II. 831.

neglected, increased in price greatly beyond their value, and superior often to the price of oriental ones when bought in the east.* At present we are not aware that they are sought for, except as curiosities.

Natural history.—This shell is common to most of the rivers of Europe, but is chiefly found in those which are violent and rapid, and in the temperate or colder climates. In Norway and Sweden they abound, and they are found plentiful in the streams of Western Siberia.† In Great Britain they are common in the English, Welsh, and Scotch, and some of the Irish rivers; in all which the fisheries were formerly prosecuted. The same opinion as to the formation of the pearls in these was held, as with respect to the last species; and the supposition, that they were formed of dew, or of eggs which had not been evacuated, was supported by scientific writers as late as the seventeenth century.

In 1761 Linnæus informed the King and council of Sweden that he had discovered an art by which muscles might be made to produce pearls, and he offered to disclose the method for the benefit of the kingdom. This however was not done, but he disposed of the secret for about five hundred ducats to a German. At the death of this man it was offered for sale, sealed up to the highest bidder, but what became of it is not known. Linnæus once showed Beekman a small box filled with pearls, and said, "*Hos uniones confeci artificio meo, sunt tantum quinque annorum, et tamen tam magni*;" and he declared that he could succeed in the same manner with all kinds of muscles.‡ They lie in the mud, generally sticking up in a horizontal position by one end.

Fisheries.—Lying generally in shallow water, little exertion or skill is necessary in procuring them, and the business was probably never sufficiently extended or valuable to cause either their cultivation or particular protection. The manner practised in procuring them in the north of Ireland in 1660, is described in the Philosophical Transactions, and exhibits neither art, nor much intelligence. In the warm months before the harvest, while the rivers were low and clear, the poor people waded into the water, and some with their toes, some with wooden tongs, and others with a sharpened stick, thrust into the open shell, brought them to the surface; and although by com-

* Macpherson, III. 419. Bruce, VII. 321.
† Cochrane's Pedestrian Tour. ‡ Beekman, II. 5—11.

mon estimate, not above one shell in one hundred might have a pearl, and of these pearls, not above one in one hundred might be round and clear, yet sufficient were found to remunerate those who sought for them. "The natives, though very foul eaters, will not eat the fish." The shells which contain the best pearls are wrinkled, twisted and bunched, and not smooth and equal as those that have none; and "the fishermen will guess so well by the shell, that though watched never so closely, they will open such shells under water, and conceal the pearl in their mouths or otherwise." They do not appear to have been laid in heaps to rot as the muscle is, but opened and the gem extracted immediately.*

The following ingenious mode of catching them was practiced about fifty years since, in the river Teith, county of Perth, Scotland, and we may remark, that it is the only instance we can meet with, where any skill or invention is obvious in the manner of fishing for them. A kind of spear was made use of, which was shod at the point with iron spoons, having their mouths inverted. The handles were long, elastic, and joined at the extremity, which was formed into a socket to receive the shaft. With this machine in his hand by way of a staff, the fisher, being often up to his chin in water, groped with his feet for the muscles, which are fixed in the mud and sand by one end. He pressed down these iron spoons upon the point, so that by the spring in the handles they opened to receive the muscle, held it fast, and pulled it up to the surface of the water.† It was customary at one time for the Crown to grant patents for the privilege of fishing for pearls in particular streams. Sir John Hawkins held a patent of this sort, and in 1633, one which had been granted to Robert Buchan of Auchmacoy, in the county of Aberdeen, was repealed by Charles the First.‡ There were also some fisheries in Saxony, which were monopolized by the government, but whether productive or not, we are not informed. They are called by the Welsh, *Cregin Diluw*, or deluge shells, as if they had been left there by the flood.§

III. Pinna rotundata? (Linn.)

Before the introduction of the silk worm into Europe from the East, this shell was of much importance in the arts. The only silk

---

* Phil. Trans. II. 831.

† Sinclair's Statistical History of Scotland, XI. 600.

‡ Ibid. IV. 423.

§ Pennant's British Zoology, *in loco*.

of any value, or in any quantity, that could then be obtained, was procured from it, and it was only gradually that it gave way before the cheaper and more beautiful fabric. The animals inhabiting the Pinnæ have the power of fixing themselves to any substance, by throwing out an extensile member, and discharging from its tip a drop of gluten, which, by the retraction of the same organ, is formed into a silky filament, and by frequently repeating this operation a thick tuft is formed, by which the shell is fastened in any situation the animal chooses.* It is of these silky filaments, which are of a rich gold color, that cloth was made; and of such value was it, that for a long time none but monarchs and persons of high rank wore it, as their robes of state.

There have been endless disputes among commentators, what material was meant among the Greeks and Romans by the word *Byssus*, and they have not unfrequently confounded the *Byssinum*, the *Bombicina*, and the *Sericum* of the ancients altogether as one. Some have supposed the *Byssinum* to be a cotton, some make it the same with the *Sericum*, and others, very fine linen. The fact however seems to be, that the word was frequently applied indiscriminately to any texture finer than woolen; but on speaking appropriately, it was used solely for the stuff manufactured from the produce of the Pinna.† It was in use during the earliest periods, as we find David,‡ B. C. 1043, clothed with a robe of it, and we can trace it as an article of commerce until near the end of the fourteenth century. The Hebrew word is *Butz*, but is in general erroneously translated, and in our version of the Bible is confounded with real linen and cotton, under the name of "fine linen." It does not appear in the text of Moses; and the only books in which it occurs are Chronicles, Ezekiel§ and Esther.|| In Chronicles we see David with a mantle of *Butz*, with the singers and the Levites. Solomon used it in the veils of the temple and sanctuary.¶ Ahasuerus' tents were upheld by cords of it; and Mordecai was clothed with a mantle of purple and *Butz*, when king Ahasuerus honored him with the first employment in his kingdom, about B. C. 509. It was among the merchandize imported into Tyre from Syria, enumerated by Ezekiel,

* Dillwyn, III. 24.

† "*῾Αι δε πινναι ʼορθαιφυονται ʼεκ βύσσου ʼεν τοις ʼαμμωθεσι και βορβορωδεσιν*;" and Duval in explanation adds, "*ex bysso, id est, villo, sive lana illa pinnali.*"—Aristotle, Oper. omnia. Paris, MDCXXIX; tom. II. p. 844.

‡ 1 Chron. xv. 27.

§ Ezek. xxvii. 16.

|| Esther, i. 6. vii. 15.

¶ 2 Chron. iii. 14.

B. C. 588. Lastly, it is to be observed that there was a manufactory of this article in the city of Beersheba in Palestine.*

The *Butz* must have been different from common linen, since in the same place where it is said David wore a mantle of Byssus, we read likewise he wore a linen ephod. Herodotus (B. C. 450) says, that the bodies of rich persons in Egypt were wrapped in bandages of it, after being embalmed.† In the time of Pliny, the Roman ladies were particularly fond of it, and would buy it for its weight in gold.‡ In the New Testament the word frequently occurs, where it is translated the same as in the Old, but always indicating riches and splendor.§

In later times, it was chiefly brought from India, Egypt, and Elis in Achaia, and some apparently from the coast of Judea. In 1265 it was imported from Asia into England,|| and in 1380 we find five bales of it mentioned, in the catalogue of the cargo of a ship bound from Genoa to Bruges in Flanders, and which was driven ashore on the English coast.¶

It is still manufactured at Palermo into gloves and other small articles.** It is also used at Taranto, (the ancient Tarentum,) where it is called *lana pesce* or *lana penna*. Having been cleaned, combed, carded and spun, it is finally knit into stockings and gloves of a soft and extremely warm texture, and a beautifully glossy brown color, enriched with a golden hue. They are reckoned excellent preservatives against cold and damp, but the price renders the article more an object of luxury and curiosity than of general utility.†† To spin this Byssus they leave it some days in a damp cellar, to moisten and grow soft; after this they comb it to get out its impurities, and lastly spin it as they do silk; and though grossly spun, it appears much finer and more beautiful than wool, and does not come much short of silk itself.‡‡ A species of Pinna is much fished for in the Red Sea, as it contains pearls. The inside is of a beautiful red, and the pearls always partake of this color, while they are generally the darkest as they approach the large end, which is the most brilliant.|||| Bruce supposes, that from this circumstance, the Hebrew word *Penin*, or, as it is more generally written in the plural,

---

* See Calmet's Dict. Art. Byssus.

† Σινδόνος βυσσίνης. Herod. lib. II. cap. 86. Compare also the Greek of Luke, xxiii. 53.

‡ Plin. Hist. Nat. lib. XIX. cap. 1.

§ Luke, xvi. 19. Rev. xviii. 16, &c.

|| Macpherson, I. 415.

¶ Ibid. V. 590.

** Dillwyn, III. 24.

†† Hon. Keppel Craven's Tour through the southern provinces of the kingdom of Naples, p. 185.

‡‡ Rees' Cyclopœdia, Art. Byssus.

|||| Bruce, *ut supra*.

Penemin, Pearl, is derived, as the root of it signifies *red*, and that it was from these shells the pearls used in Judea were taken; of course it is impossible to decide, as oriental pearls are also found thus tinged, but it is not improbable.*

The derivation of the word *Byssus*—βύσσος, is probably βυσσὸς, *Ionicé* for βυθὸς—depth, as being found in comparatively deep water. The word Pinna has been idly supposed to be derived from the Latin word *penna*, a feather—from an imagined resemblance between the shell and the quill. The Greeks, however, used the word πινα or πιννα, and must have derived it from the Hebrews. Bruce asserts, that in the Red Sea they live in the mud without any byssus, sticking up horizontally on the sharp end; he is, however, most probably mistaken. They were the only shell fish that he found there not eatable.

IV. Mytilus ———? (Linn.)

There is another shell in the Red Sea, which is regularly sought after as containing pearls. It is a Mytilus, and appears nearly to resemble the *M. edulis*. It is the rarest kind, and is chiefly found at the north end of the Gulf, and on the Egyptian side. The only place where Bruce ever saw them, was about Cossier and to the northward of it, where there was an ancient port, which took its name *Myos Hormos*, the *Harbor of Muscles*, from their locality. The fish contains often pearls of great beauty for lustre and shape, but seldom of a white or clear water. They lie in the deepest and stillest water and on the softest bottom, and they stick upright by their extremity.†

V. In Australasia we are told of another large pearl-bearing shell, but of what genus we are not able from the accounts to decide. It is the Menangey—occasionally denominated the New Holland cockle, and it produces large and beautiful pearls. Mr. Dalrymple mentions one belonging to Lord Pigot, which weighed 8 dwt. 17 grains, and was $\frac{48}{50}$ inch in length, and $\frac{38}{50}$ inch in diameter.‡

(*To be continued.*)

* Statius (*Silviæ*, 4. 6. 18.) uses the phrase '*Erythræus lapillus*,' and some other writers make use of the words '*Erythrææ gemmæ*,' for pearls, but whether from their red hue, (ερυθραιος) or because they were from the Red Sea, *Erythræum Mare*, is questionable. Pliny says that the pearls from this sea in his time were the most orient and clear. Plin. ix. 35.

† Bruce's Abyssinia, VII. 314, and VIII. Plate 43.

‡ Burney, Chron. Hist. of Dis. I. 94.

Art. VI.—*Notes on a Tour in France, Italy, and Elba, with a notice of its Mines of Iron;* by Prof. F. Hall—in a letter to the Editor, dated Porto Ferrajo, Elba, July 24, 1836.

TO PROFESSOR SILLIMAN.

Dear Sir,—Being wind-bound, in the capital of this romantic island, and without occupation, I have concluded to spend an hour this morning in telling you something of what I have seen on this side of the Atlantic. You are aware that I embarked at New York for Havre; eighteen days brought me there. From that port I travelled, in an elegant and commodious steamboat, up the serpentine Seine, through a country whose landscapes are enchanting, and not surpassed in richness and variety, by any in the United States, those of the Hudson, perhaps, excepted. The land, as you proceed up the stream, is first level, or slightly uneven, then more undulating—the waves growing larger and larger till you come into the neighborhood of Rouen, where I landed, and where the surface is hilly, and even mountainous. The geological structure of the banks is very apparent and curious. Most of the rock of which they are formed, seemed to me as seen from the boat, to be sandstone. At a considerable distance from Havre, however, the gray carbonate of lime appears, and still farther up, granular gypsum. The rocks all lie in strata nearly horizontal, but of very unequal thickness. I remained but a few hours in this ancient city, famous for its manufactures, its high houses, its narrow streets, and its cathedral, which is exceedingly splendid, and deserves attention from every traveller. After refreshing myself with a good dinner, and taking a bird's eye view of the wonders of Rouen, I posted off, moonlit, for the French capital. There I met some old friends, whom the grave had not yet claimed, and made a few new ones. Paris is not what it was when I saw it nearly thirty years ago. Improvement has made giant strides in every thing—in the pavements of the streets, in the private and public edifices, in the national gardens and squares, and in the royal palaces. I remained in that gay city twenty days only, and then took my place in the diligence for Chalons, on the Saone, passing through Sens, whose archbishop formerly assumed to himself the modest title of "Primate of the Gauls and Germany," to Avallon. This small city stands on a *plateau* of granite, and it is the first granite I had observed *in situ* after leaving Paris. Indeed, the principal rocks which I saw between these two cities, are sandstone, limestone, and gypsum. In the neighborhood of Avallon I picked up, near the road side, several good specimens of ammonite. I reached Chalons at noon, having been imprisoned in the diligence forty eight hours, without regular meals, and without much sleep. Chalons, you know, is the Gabilonum of the Romans—a place of business and bustle, being the great thoroughfare of the merchandize going from the south to the north of France, and to the United States. Steamboats ply daily on the Saone, between this city and Lyons. The river is about half as large as the Connecticut at Hartford. I took passage in one of these *bateaux á vapeur*, for Lyons.

From the water, several ancient towns and cities were pointed out to me, the thrilling tales of the heroic deeds of whose inhabitants I had read in my youthful years, and wept while I read them; savage however, they may be better called, than heroic. Macon drew my eye, and fixed it. Here the innocent Huguenots were drowned by hundreds, by order of the bigoted governor; history tells more of this matter than I wish to remember. The entrance to Lyons on the river is exceedingly delightful; this city rests on a tongue of land, formed by the confluence of the Saone and the Rhone—the Rhodanus of Cæsar, and, Paris excepted, acknowledges no superior in France; its population is one hundred and sixty thousand. A Roman consul founded it forty years before the commencement of our era. Its silk fabrics are known over the whole earth—they are worn by all nations.

I took my departure from Lyons in the twilight of the morning, in a steamboat which descends the river to Avignon; an old city, walled up to heaven, and gloomy, as was the Bastile in 1750, containing the tombs of some of the popes, who once resided here, and the grave of Laura, or at least a monument to her memory, standing in a retired garden, and surrounded by the sepulchral cypress and willow.

The scenery presented to the eye as we moved down the Rhone, could not be too much admired, and yet the country disappointed me. It is less fertile, and more broken, hilly, and mountainous than I anticipated finding it. Over thousands and thousands of acres sterility reigns, and will eternally reign unmolested. Nothing shows itself on the surface but naked, weather-worn rocks, thrown into all imaginable fantastic shapes. But every nook of earth that is tillable, is used to the best advantage; not a yard, not a foot is lost. The sides of even the most precipitous mountains are terraced high up, exhibiting the appearance of a vast *escalier*, each step of which is set with the vine, then sending forth copious, verdant foliage, interspersed with fair promises of an abundant harvest.

The Rhone is wonderfully tortuous in its course, and filled with islands, which materially embarrass its navigation. The water is shallow, and the current rapid, but not broad. In size and importance it is surpassed by many of our New England rivers; at Avignon, it is perhaps half as wide as the Delaware at Philadelphia. "Does the country resemble ours?" No, sir, not much; it is more rocky than Maryland, or Vermont, or Massachusetts. "What is the nature of the rocks?" They are principally calcareous. "How do the mountains differ from the Blue Ridge of Virginia, or from the Green Mountains of New England?" They are more angular, more irregular in their forms—have a much greater number of peaks. These peaks are more acuminated, run higher above the body of the mountain, stand nearer to each other, and seem to have been produced, as I have no doubt they were, by the ejection of earthy matter, partially fused, from a thousand little volcanic craters.

"Is the country more interesting to the traveller than ours?" I think it is. Not that it is wilder, or naturally more romantic, or picturesque; nature has done more, far more, for America. But art, and old age, and superstition, and feudal customs, and volcanic fires, have done every thing here. The ruins of ancient castles, and "deserted chateaux and convents, placed on the pinnacles of craggy rocks," present themselves to you at every turn of the river, as you move down the Rhone. The falling tower, the crumbling statue, the moss-clad mouldering arch, the antique, costly tomb, all tell you, in language that cannot be misunderstood, that hundreds of generations of men have been born here, have toiled and died; that genius, and wealth, and power have dwelt here, and left monuments of their achievements for the admiration of all after ages. Yes, sir, it is the old age of the land—the antiqueness, the gloomy remembrancers of the deeds of days long ago past; it is the granite column, which is uninjured by the wear and tear of a thousand winters—it is the sculptured marble chiselled by hands, centuries since, turned to dust. These, and a host of kindred objects, give the charm, the thrilling charm, to the countries I have passed through, and this charm the new world does not possess.

At noon I left Avignon for Nismes, in the diligence. The ride was delightful—the country better cultivated, and more beautiful than any which my eye had yet rested on. The first two miles were on a gradually ascending plain, covered on all sides, and to a great extent, with mulberry and olive trees. The latter, at a little distance, bear some resemblance, both in size and foliage, to our common willow. They were innumerable; I am confident, that between Avignon and Nismes I passed millions of them; they form, a great part of the way, an almost uninterrupted forest. Wherever the olive occurs, there you may expect to find the vine accompanying it; they occupy the same ground, and flourish well together. This tree is long-lived; some of the orchards I passed were said to be more than two hundred years old. It is not large, never reaching the size of our largest apple trees. The fig tree was seen in that region, here and there, and the almond tree in vast numbers, loaded with fruit, nearly mature.

Nismes, called Nemausus when Hannibal was there, is one of the best built, and cleanliest cities of France. It has a population of forty thousand inhabitants, and is celebrated, as you well know, for its antiquities—its oval amphitheatre, four hundred and forty two feet in length, and seventy in height; its Corinthian temple, and its Roman baths, all in a state of tolerable preservation. I can only say, that every traveller, who visits Italy to see its ancient monuments, ought first to visit Nismes.

My next fifteen miles lay through an almost unbroken wheat field. Few mulberry, or almond, or olive trees were visible, and but little grass. This brought me to a canal, commenced by Napoleon. In a dirty boat, drawn by a single horse, I travelled fifteen or twenty miles; the diligence then took me up, and brought me to Marseilles, where I embarked on board the new and splendid steamboat Phocion, now on her first voyage of pleasure around the Mediterranean. On the first of June we anchored in the bay of Genoa, or Genes, as it is there called, where the city exhibited itself in the most favorable point of light. Indeed, its situation, spread out on the sides of lofty, converging mountains, forming a magnificent semi-amphitheatre, is more eminently beautiful than that of any city I have seen in either hemisphere. Its objects of curiosity are rich and multifarious; its palaces are sumptuously decorated with elegant columns, and statues, and paintings. I looked at them till my eyes were satisfied. This, you know, was the birth-place of Christopher Columbus, the greatest navigator—perhaps I ought to say, the greatest man, the world has yet produced. I searched two hours for his house, but searched in vain. The spot, one told me, where he first saw the light, is on a small stream a mile or two distant from the city.

At the close of the third of June we moved off for Leghorn, which contains little to attract the attention of a man whose object in going abroad is not commercial. I therefore took a trip of fourteen miles to Pisa, a city built soon after the overthrow of Troy; and was nobly rewarded by a view of the Campanile, or Leaning Tower, the Duomo, or church in the form of a Latin cross; the Baptistery, or the edifice in which baptisms are performed, and the Campo Santo, or ancient burial ground. They fill the bosom of the gazer with astonishment; the sight of each of them is worth a journey from Moscow. The Leaning Tower I most admired; it is of a circular form, one hundred and ninety feet in height, consisting of eight stories, and ornamented with two hundred and seven granite and marble columns. I mounted, by an easy, winding staircase to the eighth story, where I had a commanding prospect of Pisa, of a broad zone of land encompassing it, and of many conspicuous objects far distant, among which was Leghorn. It is believed that the tower was originally perpendicular, and that its present declining position was occasioned by an earthquake, or by some other physical phenomenon. You will not allow me to speak of the abode of the illustrious dead, and tell you that it is "a vast quadrangle, surrounded by sixty light and elegant Gothic arches, composed of white marble, and paved with the same substance;" that it contains sarcophagi innumerable, of Parian and Luni marble, ancient vases and rich frescoes, cinerary urns of alabaster, and paintings of enormous size. I must leave the magnificence of the interior of the Duomo—its high altar, ornamented with lapis lazuli, verd antique, bronze gilt, &c.—its porphyry columns, its group of angels, all must be left for you to imagine.

The next pause the Phocion made, was at the little filthy city of Civita Vecchia, whose harbor was built by Trajan, who had a villa in its vicinity. Here she remained eight days, for the purpose of giving her passengers an opportunity to visit the "Eternal City." This period being expired, she brought me to Naples, or Napoli in Italian, which stands at the extremity of my *voyage*. I remained in that city of business and noise eight days, examining its *merveilles*, and those of the region around it; in treading the narrow streets of

Pompeii, and gazing at its untombed wonders, its edifices, its altars, and its gods; in groping my way in the deep and dark theatre of Herculaneum; visiting the lake of Tartarus, now Avernus; the old city of Puteoli, where St. Paul resided seven days; the tomb of Virgil; the Grotto del Cane; the Monte Nuova, or New Mount, "formed in thirty six hours by a volcanic explosion of 1538;" the Stygian Lake, the Elysian Fields, &c. &c., or inhaling the sulphurous odors of the still smoking Solfaterra, or in clambering up the lofty, ashes-clad Vesuvius. This being accomplished, and more, I came to Rome by land, travelling on the *Via Appia*, much of whose ancient pavement is yet visible, consisting of stones a foot or more in length, six or eight inches in width, and perhaps as many in depth, and passing near the spot of ground on which the *second* orator the world has produced was basely murdered, and over the Pontine marshes, of which our company felt no dread.

I shall say nothing of Rome, except to remark, *en passant*, that it is far the most interesting city I ever entered. I do not mean *modern Rome*. Burn St. Peter's, and what adjoins it, and young Rome would be infinitely inferior to London, to Paris, to Edinburgh, and to many other cities in Europe. No, sir, it is the old Rome, with which I was enraptured; where Horace was, and Cicero, and St. Paul; where Cato lived, and Virgil sung, and Cæsar bled; where are monuments still visible, which tell the tales of other times, the Via Sacra, the Tarpeian rock, the triumphal arches, the aqueducts, the Coliseum! What a luxury it would be to you, sir, who are an admirer of the Latin classsics, to plunge into this ocean of speaking ruins, and spend weeks and months in it!

A voiturin conveyed me to Florence, over a country of hills and dales, of mountains and valleys, overspread with the best of earth's blessings—corn, wine and oil; a land of figs, and almonds, and pomegranates and olives. I did not sojourn long in this splendid city. The heat was oppressive, and yet not more oppressive than it often is at Washington or Philadelphia. Indeed, the summer heat of Italy is, I am persuaded, quite as tolerable as that of Maryland or Virginia, and the climate not a whit more unhealthy. My stay in Florence was, however, long enough to give me an opportunity to examine most of its curiosities. I early betook myself to the church called "Santa Croce," where repose the ashes of Italy's noblest sons. On one of the walls is placed a simple epitaph over the tomb of that wonderful man, Galileo. On the opposite side are the chaste and beautiful sepulchral monuments of Dante and Michael Angelo. The chisel has here done its best to perpetuate many illustrious names which I cannot now enumerate. The museum is rich in objects of art, and of the natural sciences. I have seen no collection of minerals so large, and so valuable, except that of the Jardin des Plantes at Paris. The galleries in the ducal palace are bewitchingly attractive, adorned with the finest paintings and statues, glittering with the richest articles of furniture, with sumptuous vases, and tables, composed of the most costly and splendid minerals, inlaid, such as malachite, amber, lazulite and many of the gems.

Florence is sometimes termed "the city of palaces," and is rightly named. The palaces are numerous, and many of them exceedingly elegant and capacious. Eleven of them were for sale when I was in the city. Would you know the value of a palace in Florence? At my request, our consul took me to the man, who had the disposal of one of them. It was finely situated, was four stories high; had fourteen apartments, and some of them very spacious, on each floor, or fifty six rooms in all. The price demanded for the entire palace was *seven thousand and three hundred dollars,* or it might be rented for any length of time, for *three hundred and seventy five dollars a year!* I left that noble and lovely city with deep regret, and made my way to Leghorn by land.

Unwilling to prosecute my journey into Switzerland, without seeing Elba, that singular island, celebrated the world over for its mineral productions, and scarcely less celebrated as having been the place of Bonaparte's temporary confinement, I engaged a passage to it in an open crazy boat, as no other could be obtained at the time. The distance is forty five miles. She set off from Leghorn at noon. I spent a sleepless night on the waters of the "Great Sea," having the heavens for my canopy, and a plank for my bed. At six, the following morning, I rejoiced to arrive in this city, Porto Ferrajo, which is finely situated on a broad and safe bay, capable of affording good anchorage for five hundred ships of war, and strongly fortified, containing about seven thousand inhabitants, three churches, one theatre, the *hotel de ville,* and the governmental palace, in which I am writing this communication. This last edifice was in part erected, and was inhabited by Napoleon. The American consul at Leghorn, Mr. Appleton, very politely gave me a letter of recommendation from the governor of Leghorn to the governor of the island of Elba. It procured me the kindest reception, both from the governor and all the officers of the government. I was received into the governor's family, and requested to occupy a chamber in the palace while I remained on the island. This officer is a gentleman of unaffected politeness, of great simplicity of manners, and is much loved and respected by the islanders.

Elba is about sixty miles in circumference, of an irregular oblong figure, its longer diameter running from west to east. Its surface is exceedingly uneven, being thrown into every imaginable shape; there, rising into mountains two or three thousand feet in elevation; here, sinking into deep vallies. Some of the high lands are covered with vegetation, but most of the summits of the mountains are naked, and exhibit nothing but rocks, which a hundred centuries have rendered almost as white as Parian marble. The vallies are productive, yielding grapes in vast abundance, and grain of various kinds, the fig, the orange, the watermelon, (which is here called *cucumber*,) pears, apples, plumbs, &c. &c. The number of inhabitants in the island is about fifteen thousand. They are principally in Porto Ferrajo, and the villages of Longone, Capoleon, Marinna and Campo. There is little wood on the island, and what there is, is a small growth. Jackasses, loaded with faggots, and pieces of wood two or three inches in diameter, are constantly seen coming into Porto Ferrajo from the country. The oak grows here, and the maple, and several other trees, which are common in America: but there is one here that I have not met with before; it is the cork tree, whose bark is thick, and is used for stoppers of bottles, to make lines float on water, &c. I have cut a stick of it, which I shall have converted into a cane when I arrive in Paris.

The geological structure of Elba is different from any other part of Italy. I saw no decidedly primitive country between Avallon in France, and Naples. There may be land of this character in Italy, and the south of France, which I did not see. I infer from what I saw, that the whole country of which I speak, was of volcanic origin: in some places the lava is old, and in others young, but always bearing evident marks of igneous fusion. I have crossed the Appenines twice; once over Mount Somma, one of the highest, where I expected to find primitive rocks, but found nothing but secondary limestone, full of pores, once, doubtless, filled with gas, and a combination of other materials, which nothing but intense heat could have generated. This island presents a curious mixture of primitive and volcanic formations. The rugged mountain which you see at the right hand as you enter the harbor of Porto Ferrajo, has all the appearance of having been ejected from the earth by an internal energy; whereas those massy piles which stand on the south and east of the island, bear no *obvious* marks of fire, although they, too, may have been raised, at a more remote period, by that agent. I have spent a week here, and seen many of the mineral productions. I shall enumerate some of those which I have seen, without any regard to system. There are probably others which have not come under my observation.

1. Rock crystals, of various sizes, from a line in diameter to two inches; all in the form of the hexagonal pyramid at one extremity, and some at both; some diaphanous, as the purest water, and others entirely opaque.

2. Feldspar, crystallized and massive.

3. Tourmaline. It often occurs in the feldspar. I found a vast quantity of it in rolled fragments, lying along the northern shore of the island, and it must have been brought there by the waves of the sea. Some of the balls were nothing but black tourmaline, (schorl;) others were a mixture of this substance with feldspar.

4. Rubellite, in beautiful crystals, but not enveloped, like those of Chesterfield, in green tourmaline.

5. Aqua-marine, not plentiful, but sometimes found.

6. Epidote, crystallized, and in irregular masses.

7. Jasper, red, green, and brown; very abundant.

8. Porcelain earth, or decomposed feldspar, in different parts of the island. The manufacture of this article into porcelain, or China ware, might be made a source of revenue to the government, were fuel more plentiful.

9. Limestone, primitive and secondary, red, white, and sky-colored. The white is capable of being converted into a marble, little, if at all, inferior to that of Carrara. The red, too, when polished, strongly resembles the best of the Rouge Antique of Rome.

10. Arragonite, in the shape of calcareous stalactites.

11. Mica, silver white, green and black.

12. Yenite, jet black and brown, crystallized and massive. The crystals usually occur in groups, which are, occasionally, large and splendid. Formerly, yenite was abundant here, but at present good crystals are rarely to be met with, and when bought of the inhabitants, they are purchased at a high price. I have obtained, by discovery and by purchase, a good number of specimens. A large group

of crystals of yenite was offered to me by a gentleman of this city, who estimated its value at the moderate sum of *three hundred piastres* or dollars.

I have made several mineralogical excursions, on different parts of the island. In one of them only, I will ask you to accompany me. Having provided myself with a guide, the only practical mineralogist on the island, and being furnished with little horses, accustomed to climb mountains—by the way, I had the same pony, as the guide told me, which Napoleon had rode, with a rope bridle, over the same grounds—we first passed the bay, which is two or three miles across. We then ascended a ragged mountain, probably three thousand feet in height, composed chiefly of micaceous schist and jaspery ironstone. On the almost inaccessible summit of this mountain, stand, frowning on the world below, an old tower and fort, built at an unknown period. Descending, we found on the eastern slope the ancient village of Rio, consisting of about one hundred houses. It is placed on a succession of serpentine rocks, both precious and common. We descended into a narrow valley, where the walls, along the sides of the road, were formed principally of serpentine and common jasper. After travelling a few miles further, we came to another mean and filthy village, called also Rio, but to distinguish it from the other village of the same name, and because it is situated on the margin of the sea, it is denominated *Rio Marina*. There was yet another lofty elevation to climb, before I could gain a view of the famous mine of specular oxide of iron, to see which was the main object of my visit to Elba. All this part of the island seemed little else but a vast ore bed, made up of the sulphuret, the sulphate, the specular and the magnetic oxides of iron. Winding our way up the mountain by a most zigzag path, we met hundreds of donkies, almost crushed to the ground by the astonishing loads of the ore, in baskets, two tied together and slung across their backs, which they were bringing down to the vessels lying in the harbor ready to receive it. I pitied the poor animals, *imo pectore*, as I have often done before. Indeed, the ass is the animal the most used and the most abused in Italy, always toiling from break of day to dusky eve, willing to eat any thing, and yet always starved; if among the slippery ledges he makes a misstep, he is sure to be lashed for it; and yet is patient and uncomplaining, under all his hardships and cruel treatment.

The surface of the ground, in many places, exhibits a very curious appearance. The sides of the ravines, produced by the force of the water, rushing down from the highlands, look as if they were covered with a thick green moss; but, on approaching, I discovered that the substance was copperas, or the sulphate of iron crystallized. In other places, it is carpeted by nearly pure sulphur. The summit of the mountain is taken off. The removal of an immense amount of the ore, has converted a large area of the highest land into an horizontal plain. On this plain is situated a round building, called the Coliseum, in which visitors take repose, and in which, I believe, an account is kept of the labor performed by the workmen. Near to this edifice is a grotto, in the mine, made by the ancients, in which have been found hammers, wedges, and other instruments, used by them in digging out the ore. The ore is obtained in the same manner here, that it is in America, by blasting, wedges and pounding.

I was a little surprised, on learning that no metallic iron has been obtained in modern times, from this excellent ore, in the island of Elba. The work is done elsewhere, in Sicily, Turkey, and Spain. It is all conveyed to foreign countries in the ore. It was smelted here in old times, but has not been in modern days, nor can it be, for there is no fuel here which can be spared for this purpose, no mineral coal, and next to no wood. After procuring a large variety of specimens of the different substances found in this neighborhood, I returned to Porto Ferrajo, well satisfied with my day's work, but not a little fatigued.

To-morrow I trust a good wind will carry me back to Leghorn, whence I shall, as soon as possible, pursue my course to the snow-capped Alps.

You will, I hope, my dear sir, excuse me for troubling you with a much longer communication than I at first intended.

Yours, most respectfully.

Art. VII.—*Notes on Chemistry, &c.*; by J. W. Bailey, Acting Prof. Chem. &c., U. S. Mil. Acad. West Point.

1. *On a new Test for Nitric Acid.*—Chemical reagents may be divided into two classes; first, those which produce with the substance they are employed to detect, an action which they will produce with no other known body; an example is starch, as a test for free iodine: secondly, those which cause a certain action with a *small number* of bodies, which they will not exhibit with any others; as, for example, sulphuretted hydrogen, which causes a black precipitate with a *few* metals.

The first class are, of course, the most valuable reagents, as they require no subsequent operation to determine whether certain substances are present or not; while with those of the second class, we only determine that one of a certain number of bodies must be present, but must then resort to other means to ascertain which particular one it may be.

There are many cases, however, when we may know that only one of those bodies which are capable of giving similar results with the reagent added is present, and then if this result *is* produced, the evidence is as satisfactory as can be desired.

The test which I would propose, must be placed among those of the second class, and is therefore inferior in value to morphia as a reagent for nitric acid; but I think it *at least* as valuable as the method by means of gold leaf and hydrochloric acid, or by the bleaching of indigo.

The substance I now suggest, as a new reagent for nitric acid, is the cyano-hydrargyrate of iodide of potassium, discovered by M. Caillot. It is formed by mixing together bicyanuret of mercury and iodide of potassium, (one equivalent of each,) dissolved in small quantities of warm water. It soon crystallizes in a very beautiful manner. This is the same salt which has recently been recommended as a means of detecting the presence of hydrochloric acid in hydrocyanic acid. (See Lond. and Ed. Phil. Mag. Nov. 1835.)

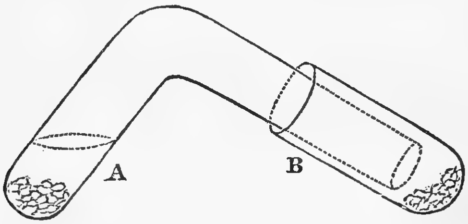
Its use as a test for nitric acid depends upon the fact, that if one of the scale-like crystals be introduced into *most* acids, it immediately becomes of a beautiful *red*, being changed into the bi-iodide of mercury; while in *concentrated* nitric acid, (spec. grav. 1.4 to 1.5,) the scale instantly becomes almost black, from the liberation of iodine.

A scale of the salt introduced into a drop of the acid no larger than a pin's head will show the effect distinctly.

The acids in which I have found the salt to *redden* are, sulphuric, hydrochloric, hydrofluoric, chromic, phosphoric, (if slightly diluted,) and the common vegetable acids, such as oxalic, tartaric, citric and acetic acids.

I have found it to blacken with chlorine gas, solution of chlorine, (recently prepared,) bromine, sulphuretted hydrogen, nitrous acid vapors, and *nitric acid.*

It is highly probable, that it would be blackened by bromic acid and chloric acid, and possibly by iodic acid, but I have not at present these acids in a free state to determine their action; the method, however, in which I use the test will prevent any fallacy from the presence of chloric, bromic, iodic or chromic acids, and of sulphuretted hydrogen. It is to evaporate the supposed nitrate to dryness, and introduce into a tube retort A, (see the figure,) a small portion of the salt, on which a few drops of sulphuric acid are to be poured;



then on applying moderate heat, by means of a spirit lamp, a portion of the volatile products are to be driven over into the receiver B, in which a few scales of the salt are previously placed. If these are blackened, the salt is to be considered as a nitrate, provided the presence of those few substances which might cause the same result has been guarded against. Now by the very method proposed, viz. evaporating to dryness and adding sulphuric acid, the presence or absence of chromic, chloric or iodic acid and sulphuretted hydrogen will be determined; for the color of a chromate, the evolution of peroxide of chlorine from a chlorate, the liberation of iodine from an iodate, and the odor from a sulphuret, will at once decide with regard to each. As iodic and bromic acids, even if they are found to blacken the salt, are not sufficiently volatile to be driven over by the heat to be employed, no error could arise from their presence.

I have observed, that if the salt used above, or the bi-iodide of mercury itself, be introduced into a test tube, with strong sulphuric acid, on adding a concentrated solution of any nitrate, (except those of silver and mercury,) the red color of the scale or bi-iodide will speedily disappear, and will be followed by the dark hue of iodine. Even when the sulphuric acid forms an insoluble precipitate, the action may be seen, by stirring up the precipitate with a glass rod, when the dark spots will be easily observed.

This method of testing may sometimes be used, but is liable to the objection that a chromate, chlorate, and probably some other salts, would give the same result. It is greatly inferior to the method by distillation, as given above.

2. *Locality of Hyalite at West Point.*—Last autumn I noticed at a quarry of gneiss on the shore of the Hudson, about a quarter of a mile below West Point, a beautiful incrustation on some of the masses of gneiss which had been removed from situ by blasting. On examination by the microscope, and by analysis, I am satisfied that it is Hyalite, although gneiss is I believe a very unusual situation for this mineral.* The mineral forms a crust of about the thickness of one or two wafers, upon what appears to have been a natural seam of the rock, and it does not appear to have been produced by any decomposition of the surrounding mass. Its color is white; lustre varying from silvery or pearly to glassy. When examined by a magnifier it is very beautiful, presenting a brilliant collection of small mammillated masses, in some places opaque, and at others transparent as glass. By analysis it gave about 84 per cent. of silica, 6 per cent. of alumina and oxide of iron, and 10 per cent. of water.

Specimens are sent with this; those in the paper marked (A) show the mineral in its purest state.

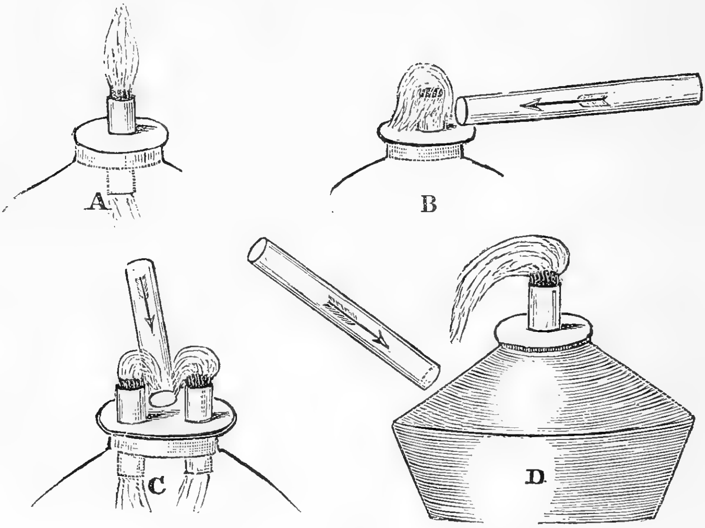
On the same surface with the above, and apparently passing into the same, was a silicious crust, which by the magnifier showed no signs of the mammillated structure, nor any lustre, but small elevated straight lines, about one fourth of an inch in length, were observed, crossing each other in various directions, and indicating an imperfect crystallization. A specimen (B) showing this character is also sent.†

---

* It is found in the gneiss at Haddam, Conn., in exactly similar form and circumstances.—Ed.

† Not received, Jan. 26, 1837.—Ed.

3. *Curious effects of a current of air on the flame of lamps, &c.*—The singular change of direction produced by introducing into the axis of an Argand burner a jet from which a current of air is forced, of which an account is given in the Lond. and Edin. Phil. Mag. for November, 1835, led me to notice some effects of currents of air on the flame of a common lamp. If a small tube, of the size of the barrel of a quill, be blown through strongly with the mouth, while in the positions shown in the figures below, the flame of the lamp will be drawn from its course *towards the orifice* of the tube in a very singular manner. The figures show some of the results.



A, the flame before affected by a current.

B, C, D, position of the flame under the influence of the currents.

These effects evidently depend for an explanation upon the same principles as the well known experiment with a tube and disk.

West Point, Nov. 26, 1836.

Art. VIII.—*A Visit to the Salt Works of Zipaquera, near Bogota, in New Granada;* by J. H. Gibbon, M. D.

On the 11th of June, 1836, I accompanied the gentleman who has the management of the Salt Works at Zipaquera, to visit that place, a distance of thirty miles from Bogota; which distance we cantered over in five hours, passing along the skirts of the mountains at the foot of which the city is built, and through the rich plain, watered by the river of Bogota, whose banks were covered with fine cattle of various kinds, while lively patches of corn, wheat, barley, potatoes, and artificial grapes, protected by Indian boys and girls from the depredations of the four footed creatures which grazed under their charge, were seen to surround the villages of low Indian huts; some of which, situated in the midst of this cultivation, are nearly concealed by trees and flowers. A few large country seats, built by the Spaniards, appeared at intervals upon eminences at the base of the hills; they are now seldom frequented by the proprietors, who prefer to live in the city; their estates are left to the care of managers, being principally employed for grazing; the cattle are said to thrive and fatten very rapidly upon them, being restrained from wandering by an enclosure of substantial stone walls. I had an opportunity of seeing the very slow and tedious process of repairing roads—an art itself altogether curious in that country; being apparently, to judge from experience of their condition, very seldom attempted. A pair of oxen were fastened by ropes to one corner of a large hide; this being drawn to the side of a hill, was filled over with earth and stones; the corners of the hide were then tied together, and the rubbish was dragged upon the ground in this strange vehicle to the spot where it was needed.

Zipaquera is an old Indian settlement, and now contains about eight thousand souls. The salt works are managed upon the same general plan pursued by the natives before the conquest, for calcining and hardening the salt, that no injury or loss might be sustained by heavy rains, in its transportation to distant stations, or in passing rivers intercepting the roads.

Upon the mountain directly above the town is exposed a huge rock of salt, of a dark lustrous color, interspersed with crystals of a purer white, called *palamos*, bleached also in streaks by the filtration of water and heat of the sun. Between the main body of salt and two distinct strata, each several feet in thickness, which lie above it, inclining at an angle of about 45°, there is a dark colored, unctuous hard clay, among which there are found pyrites, called by the natives *marmajos*, some of which are compact and unique; others, in smaller crystals, spread out upon the hard earth, form a congeries of small sparkling bodies, which have a very brilliant appearance when cleansed; these are sometimes wrought into ornaments—they look like diamonds by candle light; other specimens resembling gold are occasionally ground into powder, and used as sand upon writings.

Very near to the salt rock appears a deposit of fine limestone, called *yeso*, made use of about the altars of the churches, like stucco work, and for white washing. Sulphur is also indicated about the mine; the salt is said to contain a considerable quantity of it.

The masses of salt are dug from the rock by means of crow bars, and in its impure native state, is bought by the people of certain districts of the country, who thus prefer it; while others will purchase it only after being purified and hardened by calcination, although the price for both kinds is now the same. The consumption of grained salt, made in pans or *calderos*, is very trifling; the salt undergoes this process of crystallization before it is calcined; and it was supposed that the ability and desire on the part of the Company to supply grained salt at a lower price would increase the consumption of it, especially in the vicinity of the works. But "ancient custom" has still more influence with these people than any arguments of special or political economy; and arrangements which are well appreciated elsewhere, have often no sort of influence upon their minds, in comparison with former prepossessions. Some years ago the price of the rough natural rock salt, in the state in which it was dug from the mountain, was suddenly reduced, the expense of cutting it out being trifling compared with that of the process for calcination. As one portion of the population gave it the preference, it was presumed the consumption of it might be augmented in other districts; but the people who had formerly purchased this kind in preference, could not understand the sudden decrease in its value, and were prejudiced to believe that the salt was "rotten," as they said, or that there was some peculiar cause not apparent to them, and therefore suspected why the reduction took place; so that the Company found it better to keep the price at the former rate—there was then no diminution in the consumption. The abstract reasonings of political economy, it appears, must have reference always to the condition and information of those among whom its principles are to be applied.

The impure salt taken from the rock is principally used to strengthen the water from the salt springs which rise in its neighborhood, and contain from ten to eighteen degrees of strength; the point of saturation being twenty five degrees, regulated by an instrument graduated for that purpose. I was told that after various experiments it was found, that water at any degree of temperature would not take up more than one fourth of its weight of salt.

The water from the salt springs is received into a large basin of substantial mason work coated with cement, built in the time of the Spaniards; large lumps of the rock salt are cast in to saturate it, after which it is drawn off to be filtered into large earthen pots containing from seven to fifteen gallons, arranged in an arch of a very peculiar construction over a furnace heated by wood and bituminous coal, found in large quantities in the vicinity. From one hundred and sixty to one hundred and eighty earthen pots of a sugar loaf form, are arranged in an arch over the furnace, (which is a large, square apartment, like an open shallow cellar,) in lines beginning at each side, being supported below by the faggots and coal, and at the sides by unburnt bricks plastered with clay, which fill up the interstices between the pots, leaving here and there, apertures for the smoke to escape; after the first four hours of the process these apertures are closed up. When the rows of pots approach the center, a row of the largest size are ranged in the middle like key-stones to an arch, and the whole fabric is supported by lateral pressure, after the wood and coal which at first serve as a resting point, have burnt away and consolidated the clay which is dashed in between the sides of the pots.

The saturated salt water is at first thrown into the exposed mouths of the pots in small quantities, as a glaze; they are then gradually filled up with grained salt, prepared in the ordinary manner in large iron pans. For twenty four hours after, salt water of the highest grade of saturation is thrown in occasionally, (the mouths of the range of pots being reached by calabashes fixed to long handles,) in order to consolidate the texture throughout the mass in the pots. Fresh wood is cast into the furnace underneath the arch for twenty four hours, and the pots are left in their position for forty eight hours afterwards, to receive the heat of the cinders, which are occasionally raked up. This continued heat of seventy two hours renders the salt of a marble-like firmness and appearance; being glazed on the exterior in a manner to render it capable of resisting rain, or the water which reaches it when carried across rivers upon mules, its form being well adapted to this mode of transportation; the large loaves of salt are slung upon each side of the pack saddle. When the salt is sufficiently calcined and cooled, hundreds of poles or faggots are placed underneath the pots to receive their weight, and serve as subsequent fuel; the arch is then broken down, and the earthen ware, which adheres very closely to the salt, is cut off by a crowd of Indian women with chisels and mallets. These women are allowed as their perquisite, to take away the broken pottery, to which some salt necessarily adheres; they steep the earthen ware in water, and the saline solution is sold by them for purposes of cooking; they sometimes also attempt what is considered a contraband, by boiling and granulating it in their huts; for salt is a monopoly of the government, which formerly rented out the whole supply for a certain annual income, but now pay a company a fixed price for manufacturing it, on account of the revenue. The springs and mines are therefore carefully watched to prevent private interference.

When the "Salt Company" first undertook these works, there was much illicit working at the springs, and the agents were obliged to interfere with those who were employed in the contraband manufacture, breaking their pots and pans, and seizing the salt; the consequence was the murder of several foreigners engaged at the works; and for several years the greatest animosity prevailed between the parties. Some judicious alterations attaching the burthen of protection and seizure upon the government, and not upon the Company, and the encouragement of various industry connected with the legal manufacture, have at length caused a cessation of the hostile feelings.

The Company is now allowed 2½ reals, (31¼ cents,) for manufacturing each arroba, (25 lbs.) of salt; to this amount the government adds a charge of 4 reals, (50 cents,) per arroba, more. It costs then the consumer, or trader at the works, $3 25 per one hundred pounds, of the calcined salt; the expense of transportation is very great, and therefore the consumption is, as much as possible, economized.

When the Company farmed the rents, it paid to the government $19,133 per month, nearly $230,000 annually. Last year the government paid the Company $118,000 for making four hundred and sixty thousand arrobas of calcined salt, and derived a nett revenue of about $250,000 from its sales.

There are two establishments under the direction of the same Company. I was informed that all the salt springs in New Granada lie nearly within two straight lines, forming an obtuse angle with each other at a point where one extremity of each strikes a range of the Andes, beginning near Popayou and terminating at Chita, near the plains of Casinare, a distance of more than three hundred miles. Some salt springs are found at a great elevation in the Andes, and others in the valley of the Cauca.

The salt springs at Zipaquera are all cold; those at Chita, a distance of five days' journey, or about forty leagues, are almost all boiling hot. The cold springs are found strongest with salt; but Chita is more exposed to rains, (the rainy season continues seven months,) these are said to dilute the springs, and thus reduce the average strength of the waters. On our way to Zipaquera we passed a great number of Indians—men, women, and children, bearing upon their backs long bundles of poles, or faggots, which are sustained in that position by a bandage passed over the forehead. They bring their wood a considerable distance to the salt works for a price varying from three quartillos, or nine cents, to one real, or twelve cents, each bundle. Although coal could be advantageously used to a greater extent, it is thought judicious to encourage the industry of the people in their own way, for it can with difficulty be drawn into other channels than those they have been long accustomed to.

Upon one occasion there was a great demand by the company, who wished to extend their operations, for the earthen ware pots in which the salt is calcined: these are made altogether by the Indians. The gentleman who had charge of the works, in order to effect the supply, as he thought, offered double the usual price for these necessary articles; still there was a great deficiency. In this dilemma he applied to the priest of the parish to aid him with advice, and to know what plan he should pursue to obtain the required number of pots for the work. The padre, having heard the fact of the payment of an increased price for the pots, shook his head, and observed, that since the people received so much more money than formerly for their labors, they occupied their time in spending it, instead of making more pots. He advised that the price, which was originally three medias (18¾ cts.) for each pot, and had lately been increased to three reals, (37½ cents.) should be *lowered* to three quartillos, (9 cents.) The plan was tried, and the stores were soon found filled with a superabundance of earthen ware.

The gentlemen who have charge of the salt works are aware of the very rude manner of conducting the processes, but the want of artizans, the influence of ancient customs, and deficiency of scientific and other practical information, induce them to adhere to the old plan. Some of those however who have an interest in their works, propose to establish, at some short distance, a forge and foundery, ultimately to supply iron pots, with contrivances to allow the escape of the loaves of salt after the processes of calcination.

Although the impost of the government is so high upon the manufacture of salt at the springs, that procured by evaporation on the sea coast is not subject to any duty; and foreign salt has been permitted to enter almost free, until the last session of the congress at Bogota, when a duty of eight rials (one dollar) for every hundred lbs. was imposed.

The state of the roads in New Granada, inaccessible for the most part to wheel carriages; with its rapid rivers, navigated almost solely by canoes, makes transportation so expensive, that with the high price created by the government monopoly, salt is much economized. Strangers find themselves obliged to carry a lump of salt with their baggage, to add to the very scanty seasoning of it usual in the cooking. A salt cellar is by no means thought an indispensable part of the table equipage, and in many instances it will be in vain called for. A North American vessel was found at Buenaventura, on the Pacific, with salt brought from the Sandwich Islands: this, inclosed in hides, was conveyed up very rapid rivers into the interior, although by nature so extensively and amply supplied with it. Some of the medical gentlemen in the country are inclined to believe that the deficient use of salt has a tendency to promote the *goitre*, a disease which prevails very extensively in some districts, and for which iodine internally, and frictions with sea water and Aceyté de Sal,*

* Dr. Cheyne, of Bogota, a highly esteemed English physician, gave me the following analysis of the Aceyté de Sal, compared with that of sea water:

	Aceyté de Sal.	*Sea Water.*
Water,	0.7064	0.9691
Hydrochlorate of soda,	0.1527	0.0218
" " magnesia,	0.0450	0.0049
" " lime,	0.0930	0.0008
" " potash,	0.0002	traces.
" " iron,	0.0027	——
Hydriodate of iron,	traces.	——
Sulphate of soda,	——	0.0034
	1.0000	1.0000

oil of salt, which drains from the rock salt, have been used with advantage. Whatever may be thought upon this subject, there appear to have been, from ancient date, very decided opinions upon the utility of the general use of salt, which is craved with great ardor by many animals. It is the well known token of hospitality and confidence among the Arab tribes, and the ancient Hebrew moral law enjoins its employment as a point of religious as well as of physical propriety.

It is hardly possible to appreciate the value of such an article, until one has suffered the miseries of privation.

ART. IX.—*Meteorological Journal, for the year* 1836, *kept at Marietta, Ohio, in Lat.* 39° 25′ *N. and Long.* 4° 28′ *W. of Washington;* by S. P. HILDRETH.

Months.	Thermometer. Mean temperature.	Maximum.	Minimum.	Range.	Fair days.	Cloudy days.	Rain and melted snow. Inches.	100ths.	Prevailing winds.	Barometer. Mean.	Maximum.	Minimum.	Range.
January,	31.30	63	−10	73	17	14	2	55	W. & N.W.	29.53	29.70	29.00	.70
February,	27.23	56	−18	74	14	15	1	80	W.N.W., S. & S.E.	29.55	29.80	29.00	.80
March,	36.23	62	3	59	17	14	2	80	W.S.W., E. & S.E.	29.43	29.80	28.65	1.15
April,	44.24	89	22	67	18	12	3	87	S.S.E. & E.	29.45	29.70	29.00	.70
May,	65.76	90	38	52	20	11	6	63	S.S.E. & E.	29.37	29.65	29.10	.55
June,	69.66	88	48	40	20	10	2	04	S.E., E. & S.W.	29.35	29.55	29.20	.35
July,	75.20	86	56	30	22	9	3	92	S.S.W. & N.	29.41	29.70	29.10	.60
August,	69.80	85	48	37	20	11	3	16	E.S.E. & N.	29.43	29.55	29.15	.40
September,	68.08	88	38	50	20	10	3	16	S.S.E. & S.W.	29.37	29.65	29.10	.55
October,	45.32	76	22	54	16	15	2	08	W.N.W. & S.E.	29.41	29.70	29.10	.60
November,	36.90	75	12	63	17	13	2	50	N.N.W. & W.S.W.	29.42	29.82	29.05	.77
December,	30.70	54	6	48	18	13	2	25	W.S.W. & N.W.	29.52	30.00	28.75	1.25
Mean,	50.03				219	147	36	75		Mean range, 29.44			

Remarks on the year 1836.—The same diminution of mean annual heat, which has prevailed in the middle and eastern states for the last three years, appears still to be continued, and in the year which has passed at rather an increased ratio. To what cause or

---

A Spanish physician of reputation at Bogota, assured me that dogs and cats were occasionally subject to *goitre*, and that he had seen instances in both, although he was not aware that it prevailed among any other domestic animals. Whether some clue to its origin and causes may be discovered by the fact that those animals which feed upon the offals of our table, are alone affected by this peculiar disease, is yet to be shown.

causes we are to attribute this series of cool years, is a mystery as yet hidden from mortal ken, although without doubt it arises from the fulfilment of uniform and fixed laws in the regulation of the seasons. The succeeding series of years will most probably restore to the earth the usual amount of heat experienced in former periods. The mean annual temperature for 1836 stands at 50.03°, which is nearly four degrees below the mean heat for this part of the valley of the Ohio, as ascertained from observations made a number of years since, and is more than half a degree less than the year 1835, which was considered an extraordinary cold year. On the 28th of January the mercury fell to —10° below zero, and on the 5th of February following to —18°, an excess of cold very unusual in this climate. It seems to have pervaded the whole northern continent, and on the lower Mississippi was very destructive to exotic trees and plants, which usually support the winters of that climate without injury. On the Atlantic coast of the eastern states, the cold was more intense and longer continued, than in any year since the winter of 1779–80. At that time the inland sea, called the Sound, between Long Island and the main, near Norwalk in Connecticut, was so frozen as to bear the weight of a man, who deserted from the British troops and came over on the ice. It was now so covered with ice as to put a stop to navigation. Boston harbor was also closed, and many points about New York so frozen as to bear loaded teams, at places not obstructed in this manner since the days of the Revolution. In Ohio, the effect on fruit trees, whose vessels contain a gummy juice, as the plum and the peach, was very disastrous, freezing them so hard as to split the wood and bark into long seams, through which the sap exuded the summer following.

The mean	temperature,	for the winter months, is	29.74°
Do.	do.	for the spring months,	48.75
Do.	do.	for the summer months,	71.55
Do.	do.	for the autumnal months,	50.10

The mean for the winter is only a fourth of a degree less than that of 1835. That of the spring months is nearly three degrees less, while that of the summer is two and a half degrees greater, than that of the preceding year, and that of the autumnal months is two degrees less. The cold in the spring was continued later than usual, while the heat of autumn disappeared much sooner, especially in October and November, each of which months was more than eight degrees cooler than those of the preceding year. The peach bloomed the 26th of April, and the apple the 1st of May, which was about the same as last year, although there was very little progress made in vegetation until the last week in April, when the weather set in with the warmth of July, bringing forward the unfolding of leaves and flowers with the rapidity of a Russian summer. It exceeded any thing I have ever witnessed in Ohio, and clothed the naked trees, in the space of six days, with the beautiful garments of spring. The mean of the summer months being two and a half degrees greater than that of the former year, ripened the wheat at the usual period, that is, about the 4th of July. Other grains and fruits were also forwarded in their growth as rapidly as usual, so that they were perfected before the setting in of frosts early in October. September was with us warmer than common, the mean heat being eleven degrees greater than that of the year 1835, at which time the Indian corn suffered from the early cold in a similar manner to that of New England in 1836, while here no frost was seen during the whole month. The heat of the autumnal months being considerably less than usual, abridged to a few days the weeks of beautiful "Indian summer" weather, formerly so common to this region. The amount of rain and melted snow is 36.75 inches, which is below the annual average at Marietta. We have had more winds from the easterly points of the compass, than in any preceding year since I have kept a regular diary of the weather, which is twelve years. What effect this may have had on the temperature is unknown. The fluctuations in the mercurial column of the barometer have been greater than usual. It was at the lowest on the 10th of March, when it fell to 28.65 inches, during a gale of wind and rain from the S. W. The greatest elevation took place on the 22d of December, rising to 30 inches, wind N. W. This is higher than I have before seen it, by a few hundredths of an inch, making the extreme range one inch and thirty five hundredths for the year. Snow fell to the depth of four inches on the 16th of December, but melted away in a few days. The Ohio river has been partially covered with floating ice since the last of November, and for a few days in December was frozen across at particular bends, with open spaces between. It is now open, but crowded with floating ice.

Disease amongst shell fish.—One of the most curious phenomena of the year has been the fatal effect of an epidemic disease amongst the molluscous animals or shell fish of the Muskingum river. It commenced in April and continued until June, destroying millions of that quiet and retiring race, which people the beds of our streams. As the animal died, the valves of the shell opened, and decomposition commencing, the muscular adhesions gave way, and the fleshy portion rose to the surface of the water, leaving the shell in the bed of the stream. As these dead bodies floated down with the current, the heads of islands, masses of fixed drift wood, and the shores, in many places, were covered with them, tainting the air in the vicinity with putrid effluvia. The cause of the disease amongst the shelly race, remains as much a mystery, as that of the Asiatic cholera amongst the human family. It might possibly have arisen from the slight change made in the quality of the water, from the addition of marine salt, from the numerous salt furnaces now in operation along the borders of the river, the bittern of which, and more or less of the salt water, is daily mingling with the stream. Even a slight change in their vital element, might produce disease and death amongst molluscous animals; as in the atmosphere, fatal diseases fall upon man, from trifling contaminations.

Marietta, Jan. 2, 1837.

Art. X.—*Remarks on some of the Gold Mines, and on parts of the Gold Region of Virginia, founded on personal observations, made in the months of August and September*, 1836; by B. Silliman.

As these remarks cannot lay claim to the character of a general summary, (since they were founded on local, although somewhat numerous observations,) perhaps there can be no better course, than to give an abstract of some of the most important reports that were made on the occasion, to different mining companies.

To those who are anxious to be correctly informed, this procedure will afford a fair view of facts, as they were presented to the eye of an actual observer and enquirer; while reference for more general views may be had to the Report of the Geological Reconnaissance of the State of Virginia, by Prof. William B. Rogers, and to the more detailed account which may be given by that gentleman, when his geological survey shall have been finished.

Some details of topography and of machinery, and other local facts, are preserved in these reports, because—although they may not interest the general reader—they will serve to give a more precise idea of the actual condition and value of some of these mines, and of the promise they afford of being pursued with advantage.

Moss and Busby's Mines, in Goochland County, belonging to the Richmond Mining Company.*

The gold in the above named mines is contained in quartz. In this respect, with a single exception, they resemble all the other gold mines which I have seen in the gold region of Virginia, where the gold is in place. The rocks in which the quartz is imbedded are decidedly primary, and belong to the slaty family. Those which I have seen are generally varieties of mica slate, passing occasionally into argillite and the subordinate varieties of chlorite slate, talcose slate, hornblende slate, &c. Among these, as far as I have observed, mica slate is most predominant; and much that is here usually called talcose slate, appears to me to be mica slate. It is indeed often shining and smooth in its scales, but it wants the soapy feel that distinguishes talcose slate. The gold is therefore (as far as I have seen) to be referred, primarily, to the mica slate formation. The usual schistose or slaty structure and stratified arrangement of this rock, are here conspicuous. As is commonly the fact elsewhere, its position is inclined—frequently at a high angle with the horizon; forty five degrees, and more or less in different places. The rock is, in general, partially decomposed; almost always it is shivered and crumbly, and often to such a degree as to form earthy banks—soil above—clay farther down, and still lower exhibiting the lines of stratification and structure belonging to the original rock, but so soft as to be easily picked to pieces or cut.

The quartz in which the gold is contained is, in this region, usually spoken of as being in veins. It is perhaps not expedient to object to language that is in general use. It may, however, be proper to remark, that, in strictness, veins intersect and cross the strata at various angles; most metals are found in that situation, engaged in some material different from the rock; this material is called the matrix or gangue of the metal, and it is usually more or less crystalline in its structure, frequently affording the beautiful crystals that adorn the cabinets of mineralogy, such as rock crystal, fluor spar, calcareous spar, sulphate of barytes, &c.

* About fifty miles from Richmond and from Fredericksburgh.

Since my observations were made, I have seen, *for the first time,* the remarks of Professor Rogers on this point; he regards these as true veins of injection; his observations having been more extensive than mine, it is certainly possible I may be in an error; I can speak only from what I have seen. The auriferous or gold-bearing quartz of the gold region of Virginia (and, as far as I am informed, of the States farther south) forms, not strictly veins, but rather beds or layers—in general not interfering with, but conforming to, the regular structure of the slaty rocks of the country, and like them, descending to an unknown and probably an unfathomable depth. There is therefore no probability that the quartz will ever be worked out to the bottom or exhausted, or that it will often be found heaved or displaced by fractures and dislocations, usually called faults, except so far as this accident may have befallen the rocks themselves. This structure makes the working of these mines very simple; the miner follows, unerringly, the bed or layer of quartz; it is rarely diminished to strings or disappears, and when that is the fact, it often reappears at no great distance, in an enlarged size. The quartz is, therefore, as regular a part of the structure of the country as the slaty rocks themselves, and when it is auriferous, (as is not unfrequently the fact in the gold region,) the gold is disseminated through it in spangles, flakes and points, sometimes visible on breaking the quartz, but most usually entirely invisible, even with a powerful magnifying glass. In far the greater number of cases, the eye detects nothing but quartz, or sometimes metallic sulphurets of iron, zinc or lead; and the observer, unless previously instructed in the case, would never suspect the presence of gold, either distinct, or in the metallic sulphurets. The gold, being generally disseminated in the quartz of this gold region, it is obvious that it must have been laid by in its stony bed, at the same time that the quartz and the slaty rocks in which it is contained were deposited. This fact increases the probability that the gold will not be exhausted; no one can indeed predict with certainty, to what depth it descends or in what proportion it exists below; but no reason can be assigned, why it should cease or be found in less abundance than near the surface. The same causes would appear to have been in operation—at the same geological epoch, from the Gulf of Mexico, through the gold region, quite to Maryland—perhaps quite to Lower Canada, and possibly still farther, as some facts would appear to indicate. Gold has been found in Vermont, Massachusetts, and Lower Canada, and, *as is reported,* in New York, New Jersey, Pennsylvania, and Maryland.

The nature of this report precludes discussions of geological theory, and the omission is of the less importance, because the origin of metallic veins and deposits is still, to a degree, obscure, and the clear light which now illuminates most topics of geology, is here, to a degree, wanting; nor would it be pertinent or profitable to recite the various hypotheses that have been, or are still entertained. It is however worthy of remark, that whether the quartz veins are, as Prof. Rogers supposes, true veins of injection, or original members of the rock, the probability of their continuance, and of their continuing to be auriferous, is equally great.

The mines now under consideration, belong to what are called the vein mines, in contradistinction from the deposit mines. The latter contain only alluvial gold, or gold, at least, disengaged from rock or vein stones; it is obviously not in its original connexion; it has, doubtless, proceeded from the destruction of regular veins or beds, and of the rocks which contained them; the gold has either remained mixed with the ruins of the rocks and the veins, or it has been transported and scattered, sometimes far and wide, by the moving power of water, and buried at depths more or less considerable, in loose materials. Sometimes the gold is found immediately under the turf or soil; this happens, most frequently, on hills, but more commonly it lies in lower situations under several feet, or even yards of soil, clay and gravel, and it is most abundant next to the slate, which underlies the whole of the loose materials, and which slate is sometimes soft, being in a state of decomposition. Where the slate rocks are solid, and their strata stand nearly perpendicular, the gold has been sometimes found in the crevices between the natural layers of rock; at the Whitehall mines, in Spotsylvania County, the gold extended downward in this manner, sometimes to the depth of three feet. It should be remarked, that in the regular vein mines, the gold is not confined entirely to the solid qnartz; it is sometimes found in the slate, and both the rock itself and the soft matters proceeding from its decomposition, are occasionally washed for gold, with advantage.

The largest masses of gold have been discovered in or near rivulets, or brooks, or runs of water, called in the language of the country, branches. In such situations, pieces have been found weighing several ounces, and in North Carolina several pounds. On a branch at the Whitehall mine, gold of the value of $10,000 was found in the course of a few days, in a space about twenty feet square, and $7,000 value of gold was found at Tinder's mine, in

Louisa County, in the course of one week. It happens not unfrequently, that the vein mines are discovered in consequence of washing the earth, particularly in the branches.

Busby's Mine.—This mine is wrought in solid quartz. A shaft has been sunk to the depth of fifty seven feet, and it is intended to sink it to seventy feet, until it strikes the vein at this depth; this vein is the first or the most easterly in the series. The thickness of the quartz, as ascertained by excavating it between the strata of rock in four proof pits, which have been sunk to the depth of from twenty to twenty six feet, averaging twenty two feet, is from twelve to thirty inches, averaging from fifteen to eighteen inches. In consequence of the influx of water, it has become necessary to erect a steam engine at the shaft; the machinery is now at the place, protected by a good framed engine-house, and will be soon in operation; this, it is expected, will effectually drain, not only the shaft and the vein to which it leads, but the other veins also, which have been already excavated, and will moreover serve to work the mills. The whim* at the shaft and all the machinery connected with it, are well sheltered by a good framed building. There are also temporary log tenements for the accommodation of the superintendant and his assistants and laborers, and there are abundant materials at hand for the erection of other buildings whenever they shall be needed. The quartz in Busby's mine is very firm—its structure is coarsely granular, and it considerably resembles coarse loaf sugar; indeed, at the mine, it has been significantly called sugar quartz; much of it is, apparently, free from all foreign matter, except the inherent gold, and it is so white that even when pulverized, it shows no tint of color.

The quartz, with its included gold, is, at the mines, universally called ore. Strictly, the word ore should be applied only to *the metal* of beds and veins, and especially to those combinations of metals with other substances, e. g. with sulphur, oxygen, &c., by which their properties are more or less disguised; and it is a liberty of speech, to make it include also, the stony matrix or gangue which encloses the metallic substances that form the proper ores. From necessity I shall adopt the language now in general use in the gold region, and I will, therefore, in compliance with general custom, call the auriferous quartz, *ore of gold.*

* A technical name for the machine that winds the rope.

In general, the auriferous quartz or gold ore of Busby's mine is destitute of any metallic appearance, the pieces which, on fracture, present metallic gold, being but a very small part of the whole. Hence the surprise and delight of the spectator are very much increased, when he sees the precious metal evolved by very simple processes. I would here observe, that to obtain this, (the only decisive result,) all necessary precautions were, during my investigations, adopted to prevent error. Imposition is, indeed, spoken of, and is said to have been practised in some cases. It is however but justice to the respectable gentlemen and master miners, with whom I was conversant in all these trials, to say, that their conduct appeared to me uniformly upright and honorable, and I believe there was neither disposition nor opportunity for fraudulent practices. There is no reason whatever to doubt that the results, about to be stated in the case of both the mines, were correct; if there were any error, it was in stating the gold too low, as it is certain, that after every precaution, some of it was lost in the washing; still, it is not to be expected that a more favorable result will be obtained in the large way, even supposing that the quartz should, in the progress of working the mines, continue equally rich in gold, as the pieces that were tried; and for practical purposes (aside from science) it is always desirable that trial-processes should, in their results, as nearly as possible, resemble those that may be actually used in the large way.

The quantity of ore which has been accumulated at the Busby mine, and which now waits for the final operations for extracting the gold, was estimated by the underground captain of the mines, at twelve or thirteen thousand bushels. From a large heap, some pieces of quartz were taken at random. They were carefully examined by a good magnifier, and not a particle of gold or of any other substance, except the quartz, could be discerned. Portions were knocked off from each, and were pulverized and sifted. Of this powdered quartz, in which, during the pounding, only a few points of metallic gold became visible, six pounds were taken and washed in an iron pan in the usual way; the matters that were carried into the tub, (used as a recipient,) were washed several times, and gold, although in decreased quantities, was, in every instance, obtained from them: all these portions of gold were then amalgamated with mercury, which had been strained through leather; the amalgam was strained through silk to separate the excess of mercury, and the globule of amalgam that remained was then decomposed by heating it in a clean iron pan, until the quicksilver was all expelled. The gold that remained weighed six grains, which is in the proportion of one hundred grains to one hundred pounds, or one bushel of the ore. These one hundred grains of gold, at $4\frac{1}{12}$ cents per grain, the price paid at the United States' Mint, amount to $4.08 for the one hundred pounds of ore. In a second trial, pieces of quartz were taken, which presented some points of metallic gold to the naked eye; they were not very numerous; and still, pieces were selected which were about as good in visible metallic gold as could be readily found. Two pounds of the powder of this ore, treated in precisely the same manner, yielded six grains of gold; this, being exactly three times as much as in the former trial, gave $12.25 to one hundred pounds, or one bushel of the ore. Perhaps it is not to be supposed that the mere accident of gold being visible would, of course, indicate so rich a result; and on the other hand, the mere fact that the gold is invisible, does not, of course, imply that the yield will be as low as, or lower, than that obtained in the first trial. The average of these two trials gives $8.16 for one hundred pounds, or one bushel. It is probable that this result is too high for a general average; even half this amount would be very rich, and a quarter of it would be very safe, supposing the expenses of working the mines to be no greater than they have been generally stated to be.

It is worthy of remark, that, by report, the earth around the Busby mine yields, generally, more or less of gold by washing; and I saw this statement repeatedly confirmed by experiments made under my own eye, upon the loose earth thrown out from the pits; it was understood to be that in which the quartz veins were imbedded in the ground, and had doubtless proceeded from the decomposition of the slaty rocks.

Indeed, through the whole of the gold region, I was assured that the loose materials of the surface are generally so far auriferous, that visible gold can, in many cases, perhaps generally, be extracted by simple washing. With a small iron pan, they wash the earth in a tub, or in some brook or branch of water, and many persons in the gold region have acquired the necessary tact. They call the operation panning, and the soil, gravel, &c. is said *to pan well* or *to pan poorly*, according to the result.

Moss' Mine.—This mine is three quarters of a mile from Busby's, and both mines are about fifty miles from Richmond and fifty three from Fredericksburg. Moss' mine is situated in decomposed slaty rock, the same which, in a greater or less degree, pervades the gold region. Here, in the portions nearest to the surface, the rock is completely destroyed, and is little else than a red clay ;* lower down, it becomes somewhat firmer, and shews, distinctly, the lines of stratification and of the slaty structure. The inclination of the rock and of the included quartz veins is about forty five degrees; the direction by compass, is about N. by E. and S. by W. The diameter of the vein, which is at present wrought is, taking it at different places, sixteen, eighteen, twenty four, twenty seven and thirty inches, averaging about twenty four inches. The structure of the quartz vein is distinctly laminar; it divides easily into tabular portions, from half an inch, to four or five inches in thickness, and these pieces have cross divisions. Hence, the quartz is broken up with great ease, especially as there is no adherence of the quartz to the slate, and therefore blasting is not needed, nor are any instruments requisite except simple picks and crows, and other common tools. The mine is, at present, approached by a single inclined plane or covered way thirty one feet long in the slant, and twenty five feet deep in the perpendicular. There is another and a parallel shaft fifty feet deep, but now filled in the lower twenty feet, by earth washed in by recent rains. There is an adit connecting the two shafts which slant in the direction of the vein; the adit is seventy feet long, in the entire length, and the vein is exposed through this whole extent. I had full opportunity to examine the vein at the bottom of the mine, and it is impossible that one should be found more accessible or more easily wrought. With a view to a careful examination of the proportion of gold, I caused pieces of the vein to be knocked off in several places, at distances of twelve feet. From each of these pieces, portions were broken, and being carefully examined with a magnifier, no traces of gold could be any where perceived. They were then pounded and sifted, as in the case of the Busby mine; nine pounds were washed, and the gold was amalgamated and the amalgam decomposed by heat, precisely as in the former case.

From the nine pounds of ore, a button of gold was obtained weighing eleven grains, which is in the proportion of one hundred

* From which, by washing and subsidence, a good and very useful paint might probably be prepared—admitting of various shades by the application of heat—forming a strong color for coarse work, and an elegant one, if covered by copal varnish.

and twenty two grains for every one hundred pounds, or one bushel. This, at $4\frac{1}{12}$ cents for each grain of gold as before stated, gives $4 98 for one hundred pounds of the ore.

In another trial, three and a half pounds of the powdered ore in which no gold was visible, yielded six grains of gold, or one hundred and seventy one grains for one hundred pounds, equal in value to $6 98.

A third experiment on ore in which gold was not visible, produced five grains from two pounds, equal to two hundred and fifty grains from one hundred pounds, and worth $10 21 to one hundred pounds of ore. The average of the three trials upon the ore of Moss' mine is $7 39 to the one hundred pounds of ore; and the average of the five trials made in the two mines is $7 70. I am assured that when a mine yields one dollar to every one hundred pounds of the ore, (as the cost of working is stated to be about one third of this sum,) such a mine is regarded as profitable, and as justifying heavy expenditures in machinery and in operations of deep mining. At the Walton mine which I visited and examined, the average yield has been, as stated to me by the manager, $5 92* to the one hundred pounds of ore; and two skillful gentlemen obtained from ore of that mine between twelve and thirteen dollars to the one hundred pounds, being about the maximum obtained by me from the ore of the Busby mine.

I forbear to quote instances of a much larger product, stated to me as having been obtained from the Busby mine, because the result was procured by an officer of the mines, although I have no reason to question either his integrity or his skill. The average product at Fisher's or Hughes' mine, as stated to me at the mine by Mr. Fisher, is $3 15* for every one hundred pounds of the ore, and I infer from his statements of expenditure, that the cost is not over thirty to thirty five cents for every one hundred pounds. Comparisons cannot be made with accuracy between deposit mines and vein mines, because the expenses of working are so widely different. It may not, however, be useless to state, that at the Whitehall deposit mine, where twenty seven hands are employed, the work is profitably carried on, with twenty dollars of gold obtained at present, in a day, and it is said that two cents on a bushel would yield a good return. Being dependent entirely upon information obtained since I came into the

* And now mentioned by permission. I afterwards examined the Walton mine at another visit, and the report is annexed.

gold region, as to the expense of working the mines, I give on this head merely the reports of others, but, I would suggest that the expense must, of course, increase as the mines are sunk deeper. It is true that experience in management and improvement in machinery, operations, and processes, will tend to diminish expense, and increase the product; but the ore may not continue equally rich, and on the other hand it may grow richer; this is, both ways, uncertain, and as no human science or skill can remove this ambiguity, it follows that mining enterprises cannot be relieved from this hazard. It is, however, wise to make estimates of expenses high, and of receipts reasonably low, that the chances of disappointment may be, as far as possible, provided against. Should the trials made by me, and under my direction prove, in the event, to be a fair representation of the average produce of the mines of Busby and Moss, (provided also, that the expenses have been correctly reported,) it follows of course, that the profits must be great. Prudence would suggest, however, that the estimate should be made at a lower rate than that which I have reported; if it were taken at one half of what was actually obtained, the yield would exceed that at Fisher's mine, which is understood to be a very profitable one; and if it were estimated even at one quarter, and the expenses are no greater than have been reported, the enterprise could still be profitably sustained, unless the interest of capital should cast the balance the other way.

With respect to the sums paid for the mines, I am not called upon to speak, nor would it be proper that I should express any opinion. I would simply remark that, in my judgment, nothing could be more inauspicious to the mining interest and to the welfare of the country, than a spirit of speculation in these concerns. In an excited state of the public mind, it is rare that facts are correctly reported, or correctly viewed. The speculator, who buys merely that he may sell again, is, too frequently, ignorant of the facts, and reckless also of the consequence in regard to those who may succeed him in his obligations; flattering gains from sales of stock are reported from day to day; the property rapidly changes hands; the public mind being morbidly excited, is of course blinded, and at no distant period, accumulated ruin falls heavily upon the last in the train. This is exactly the opposite of that mental sobriety and moral rectitude which ought to govern men in all concerns, and especially in such transactions as these; it is not too much to say, that no man should either buy or sell a mining interest, unless he can, in honor and conscience, declare that he believes it can be profitably carried on.

So far as I have had opportunity to observe the gold mining region of Virginia, I am convinced, that in several places (and it is probable their number will be increased) the explorations may be prosecuted with advantage, while in other cases they will prove losing concerns. The small proprietors of land should not be encouraged to abandon their regular industry for gold hunting, and even when capitalists associate for these objects, (which is certainly the more proper course,) prudent men will be slow to pledge more than they can lose without embarrassment, certainly without ruin.

In recurring again to the mines of Busby and Moss, I have to remark that the land, (consisting as I am informed, of one hundred and eighty three acres—fifty three to Busby's, and one hundred and thirty to Moss', lying in tracts nearly contiguous,) is well wooded with valuable timber, and well watered for the purposes of mining or of agriculture. The soil is thin, like most of that in the gold region; but the physical features of the country are favorable to mining operations, the surface being formed in gentle swells; and good roads may be constructed at a moderate expense. At Moss' mine, about one thousand bushels of ore have been raised. It is due to the gentlemen charged with the management of these mines to say, that I have been most favorably impressed by their intelligence, zeal, and candor; and I with pleasure acknowledge my obligations to them for their uniform kindness, and judicious and useful co-operation during this investigation.

I am not willing to omit a deserved commendation to the master miners, both here, and at several other mines which I have visited; comparing them with persons of their profession with whom I was formerly conversant, in some of the most important mining districts of England, I am justified in saying that they appear deserving of confidence.

Mr. Forrest Shepherd, a gentleman who has had much acquaintance with the gold mines of Virginia, being present at the examination whose result is given above, and being requested by me to aid in the processes, states in a published letter, that at Moss' vein he saw the ore broken from the rock—that he counted every fragment, and broke portions in numerous places from these same fragments in order to obtain a fair average. This ore, he states, was pounded under his eye, and a part of it weighed by his own hands, and that the results given above, he believes to have been in all respects correct, both with regard to the veins and the gold obtained from them.

The Walton Mine, in Louisa County, forty miles S. W. of Fredericksburgh, and belonging to the Walton Mining Company.

The tract of land in which this mine is situated, contains one hundred and four acres. The surface is formed in fine swells and depressions, presenting hills, bounded by large curves, and vallies of similar shape. The soil is considered as good for agriculture; much better than the average of land in the gold region. There are several good springs of water, and several branches or rivulets quite sufficient for the washing of gold, but not sufficiently copious for driving powerful machinery. The land is clothed mainly with forest; the principal kinds of trees are oak of several varieties, pine, hickory, and maple: a good proportion of the trees are large, and well fitted for building or machinery, while the rest of the growth is good for fuel and other ordinary purposes. There are *passable* roads, communicating with the tract in every direction: some of them are good, and all are capable of being made so with moderate expense.

The geological structure is similar to that which pervades the gold region of Virginia generally, as far as I have seen it. In this region also slaty rocks form the basis of the country; their strata are highly inclined: they are not however placed on their edges, as in some parts of the gold country, nor dropped down to a position approaching the horizontal, as in other parts. At the place where the mine is opened, the strata form an angle of about thirty five degrees with the perpendicular, and their bearing, by compass, is considerably to the east of north. Several veins of quartz accompany the strata of slate, it is presümed quite through the territory. This is known to be the fact with the vein that is wrought, and it cannot be reasonably doubted that this is the fact also with all the others, whose *knobs*, evidently *in place*, and whose scattered ruins appear here and there above ground, although generally covered by forest, by soil, and by vegetable deposits. These veins are distinctly traced in the tract south, and it is believed, also, in that north; so that the land is fully and distinctly marked by the characteristic features of the gold region. There are also rich deposits and veins of gold in its immediate vicinity, as appears from the following facts, communicated to me by persons of good information, although not by the parties themselves.

Tinder's mine lies about two miles northeast from that of Walton. It has been explored, chiefly by surface diggings, and washings of the gravel, &c. The excavations of the surface are numerous and extensive, and within four or five years they have obtained forty thousand dollars, about seven thousand dollars of which was from a single depot. A tract belonging to Jenkins and others, lies between Walton's and Tinder's, and also immediately beyond the latter; from the Jenkins tract, by working in a careful and economical way, they obtain from two to three thousand dollars per annum, and Jenkins is in the habit of substituting a fall-working in the gold, for which he obtains one thousand dollars annually, as a compensation for his tobacco crop, which he relinquishes in favor of the gold. Within a few days, they have discovered on Jenkins' land, a vein of quartz, which is very rich in gold. A good observer, a master miner, informed me, that he saw in this vein of quartz, pieces of gold projecting from it, as large as the first joint of a finger. In consequence of this discovery, so much curiosity and cupidity have been excited, that they have been compelled to inundate the vein, until measures can be adopted for its adequate protection. At Boxley's, near Tinder's, they obtained, the first year, nine thousand dollars, and have probably accumulated twice that amount of gold in the whole. At Baker's, near Walton's, they gathered, with their own people, about five or six hundred dollars in one year. At William Goodwin's, a little south of the Walton Mine, they procured, with their own hands, about one thousand dollars, and at Childs', one mile and a half southwest, they got three hundred pennyweights. Thus it appears that there is much gold in the immediate neighborhood of the Walton Mine; there are also many places not named above, and not far off, where gold has been obtained by washing; and measures, as I am informed, are about being taken, to open some other places in this region, more effectually.

These facts are of great value, as indicating that the tract now under consideration must also be auriferous, and were its real character in this respect unknown, we could scarcely doubt that it must resemble its neighbors. But we are not left to conjecture. Four years have now elapsed since diggings and washings for surface gold were commenced here upon three branches, (small streams,) and the precious metal, being discovered in all these situations, as well as in various other places upon the land, the explorations were, for some time prosecuted with considerable energy, as may be inferred from the diggings in many places, and more especially from the great piles of gravel now lying near the principal branch. They remain still, to a great extent unwashed, and it is believed they would pay well, if subjected throughout, as portions of them have already been, to the rocker and to amalgamation. This will probably be done at some future period of more leisure and convenience. That it has not been already done, must doubtless be attributed to the discovery very soon after the surface gold had been found, of the rich vein of auriferous quartz, which, with its contents, will now claim our attention.

This vein has the same bearing and inclination as those already described in connection with the slaty rocks, between which it lies. The vein is over one foot in thickness. The quartz is, in general, firm and compact; occasionally it is porous and interspersed with iron pyrites and a dark iron ore, probably proceeding from their decomposition. The slaty rock is much decomposed—or as it is termed by the miners—*it is rotten:* it is therefore, at least in the upper strata, easily broken or cut by tools; it, as well as the quartz of the vein, is much stained by iron, and both are, to a degree, mixed in the heaps of ore. In the more profound depths of the mines, it is to be expected that the rocks will be found firm, and that they will require, (as in many mines of the gold region they now do,) blasting by gun-powder. As in penetrating into the earth we recede from the influence of the atmosphere and of the weather, we are to expect that both the vein of quartz and its rocky walls will oppose more resistance to the miner than they do near the surface. The vein of quartz which has been worked in this mine, has been penetrated by two shafts, one seventy and one forty feet deep: they are connected by two parallel adits—one of which is at the depth of forty feet and the other of seventy; the shafts are one hundred and five feet apart, but the adits are one hundred and ten feet long. The flow of water into these excavations is so considerable, that a feeble horse power, which is at present applied by buckets connected with the horizontally revolving machine, called a whim, is quite insufficient to keep the shafts and adits clear. The ore is therefore not at this time raised from the mine, nor is it now possible to descend into the adits, without several days of previous labor in raising the water.

As regards a satisfactory examination of the true nature of the mine and of the ore which it yields, this is, however, of no importance; for there is already above ground a very large quantity of ore obtained both from the shafts and adits, giving full information of the productiveness of the vein and of the quality of the ore. From the regularity, the thickness, and the great extent of the vein, there can be no reasonable doubt that it will continue for a long time to afford an abundant produce, nor can any reason be assigned why the richness of the ore should be diminished. This is indeed a point upon which human sagacity cannot give us absolute assurance, and it must always be remembered that mining operations invariably involve a degree of uncertainty, because we cannot see what is below, until our operations have penetrated to those dark recesses and brought to light their hidden treasures. A favorable presumption is, however, as well sustained in this case as it can be in any, and we therefore proceed to the very important and responsible duty of ascertaining the proportion of gold, which the ore hitherto raised will yield. For this purpose four trials were made. 1. A trial was made upon ore, believed to be as poor in gold as any average which the mine has hitherto yielded. 2. It was made upon ore supposed fairly to represent the average richness of that hitherto raised. 3. It was made upon ore taken at random, without any reference to its being either rich or poor. 4. And finally, upon selected pieces, showing gold to the eye, and supposed to be rich.

1. The first trial was made upon a portion of ore, which, last year, was prepared on a considerable scale for an average trial. It was deemed proper to re-examine that result, as the conclusion drawn from it was highly important, and had deservedly produced a decisive impression upon the opinion entertained of the value of the mine. On that occasion, ninety-two bushels of the ore, taken promiscuously, were roasted, ground, washed and amalgamated. More than five hundred dollars were obtained as the result, and the average yield was $5 92 for one bushel, or one hundred pounds of ore. These facts are given on the statement of the individuals concerned in the experiment, one of whom is still at the mine. Several bushels of the prepared ore then used are also still there. From this residuum six pounds were taken—but there was this important difference in the trial—all the visible gold had been carefully picked out during the pounding, sifting, and other preliminary operations, and the material now used contained apparently no gold, and looked

indeed like a mere mass of Spanish brown, prepared for painting; the color was darker than that of the pulverized ore generally, because it had been operated upon by fire. The six pounds of this material were then washed—the gold, now become visible, was amalgamated, and when the mercury was expelled by heat, there remained five grains of gold, being in the proportion of eighty-three grains to one hundred pounds, or one bushel of ore, and having, at $4\frac{1}{12}$ cents a grain, the mint price, the value of $3 39 for one hundred pounds.

Considering that in the trial made in the large experiment before cited, all the gold was in the ore, and that in this trial all that was visible had been picked out—considering also that in this smaller trial the proportionate waste of gold in washing was greater than in the larger, it would appear that the conclusion stated, from the examination of the ninety-two bushels, was sufficiently sustained. Under all the circumstances which have been stated, the trial now made upon the six pounds of the residuum of the great experiment, may be fairly regarded as standing for the poorer sort of ore; this will more fully appear by comparison with the other trials that are now to be stated.

2. In addition to the large mass of ore more or less mixed with the slate, and now lying at the mouths of the shafts, there is in the ore-house, a pile, supposed to contain from twelve to fourteen hundred bushels, upon portions of which the remaining trials were made. The condition of this ore is as follows: The firm masses of quartz, from the size of a hen's egg to that of a man's fist or of a human head, are mixed with smaller fragments, and with the mere ruins both of the quartz and the slate, more or less pulverized, and much of it is in the condition of powder, or of the fineness of common dirt or soil. This rude heap is, to the eye, quite uninviting; it looks like a pile of yellow ochre, mixed with dirty quartz stones, and were an uninstructed observer to be assured that it contains a great treasure, even at the lowest estimate, many thousand dollars, or possibly many thousand guineas, he would consider the speaker as trifling with his understanding. Still, although the heap exhibits to the eye, no appearance of any metal whatever, except iron rust, it is, without doubt, as will now appear, a treasure of great value.

By my direction, a hole was dug deep into the pile, and the materials being taken up with a shovel, promiscuously, just as they came, a sufficient quantity of both large and small was pulverized and sifted. Of this, six pounds were taken and washed in the usual way; the gold which now appeared in decisive quantity, where none was before visible, being amalgamated, and the amalgam strained and decomposed by fire, amounted to twelve grains for the six pounds of ore; this, being in the proportion of two hundred grains to one hundred pounds, equals $8 16 for that amount of ore. This trial would appear to be as fair a one for the ore-heap as could well be made with the same weight of the materials.

It may be important to observe, that in a visit to this mine two weeks before, although not then *authorized* to examine it *responsibly*, I was desired by Dr. Benjamin Coleman, agent for the Richmond Mining Company, and at that time with me, to pay some attention to this mine, that I might be the better able to judge of the mines in Goochland county, which I was soon to visit, and of which an account is contained in the preceding pages. I did, accordingly, then examine the condition of the ore of the Walton Mine, so far as to cause portions to be pulverized and washed from various parts, inside and outside of this ore-heap, and there was, in every instance, a yield of gold so striking to the eye, that had the amalgamation and extraction been finished in the way above described, I cannot doubt that the result would have been substantially the same with that now obtained. These facts, taken in connexion, leave then no doubt as to the average richness of this pile of ore, and of course of the vein from which it is derived.

3. The third trial was made upon pieces of solid quartz, taken at random from the heap of ore; no gold was observed upon them, but on being pulverized and washed, the powder showed gold richly, for when the usual process by amalgamation and evaporation was finished, six pounds of the material yielded thirty grains of gold, answering to five hundred grains, and equivalent to $20 41 for one hundred pounds, or one bushel.

4. The fourth and last trial was made upon pieces of the quartz, selected on account of their showing gold to the naked eye: no pieces were admitted which did not exhibit one point or more of gold; few showed more than two points, and generally they were not larger than the head of a common pin. Of this lot of ore when pulverized, four pounds were taken and washed and amalgamated; the product of gold was one hundred and thirty-one grains, in the ratio of thirteen hundred and ten grains for one hundred pounds, and equivalent in value to $133 73.

The product of the four trials was—

1. For one hundred pounds,			. . . .	$3 39
2.	"	"	"	8 16
3.	"	"	"	20 41
4.	"	"	"	133 73
				$165 69

Division by four gives the average $41 42 for one hundred pounds.

This result, startling as it is from its magnitude, is, I am certain, below the truth, because some of the gold was lost in the washings. That there was no imposition is equally certain. I went with the master miners to the ore-house the moment of my arrival: the processes were, from beginning to end, conducted under my constant inspection and that of two confidential companions, and during this time the ore-house, including every thing relating to the processes, was double-locked whenever I left it, and the keys were always about my person until we resumed our work, nor did I ever, at any moment, leave the premises while they were open.

It may be added also, that the character of the master miners places them above all suspicion, and neither they nor any one concerned in assisting in the labor, had the smallest interest in the result.

I can truly say, that I could have wished the product had been less rather than more, for I greatly fear the effect on the community of the golden dreams which it may produce, and therefore repeat the cautions already thrown out. I would suggest, that an average much lower than that actually obtained, should be the one adopted, to be acted upon. It would certainly be wise to throw the fourth trial aside, as one which, although it may be sometimes exceeded at this mine, (which I am informed has been the fact,) may not often be attained, and never except upon selected or accidental specimens. The three first trials would appear to give results such as may often be looked for; their average is $10 32 to the one hundred pounds of ore, but it would probably be unwise to form any important arrangements even upon this result. It is, I suppose, certain, that one far below this, even as low as that obtained in the first trial, would form a very safe basis of proceeding, granting that speculation has not enormously enhanced the price of the stock. As to this, as I can form no calculations whatever, I wish distinctly to disclaim any responsibility for its results. My duty is performed, in all the cases in which I have been charged with inquiries concerning the gold mines of Virginia, when I have correctly and faithfully reported their actual condition, and the produce in gold of those portions of the ore which I have examined. That the Walton Gold Mine and many others in Virginia may be profitably wrought, admits of no doubt—provided, that in all cases, good judgment, sound economy, competent skill, adequate machinery, and strict fidelity, combine their salutary influence; otherwise, the result may be calamitous, and the discovery of the precious metal in Virginia may prove a curse, instead of a blessing. There can, however, be no reason for believing that these interests will be abandoned. They will be pursued with sobriety, and in many instances with success. The enterprises are still in their infancy; experience will, in this case, as in other cases, prove the best instructress; in all probability, many rich gold deposits and gold veins remain to be discovered both in Virginia and in other States, and our country may confidently expect from its own territory, here and elsewhere, sufficient supplies of gold for its coinage, for the demands of the arts, of ornament, and of use, and not improbably for exportation.

Prof. Rogers, of the University of Virginia, inspected this mine in April, 1836, in company with Mr. Forrest Shepherd: they give the following results.

1. In the lower adit leading from the main shaft, which was examined throughout, the auriferous vein of quartz rock presented a very uniform thickness, varying from a little more to a little less than twelve inches in width.

2. The talcose rock, underlying the vein, is also auriferous to a distance of six inches, and sometimes more, from the quartz.

Prof. Rogers was strongly impressed with the continued yield of gold obtained from the quartz, by pulverizing and washing, and by the uniform dissemination of the gold throughout the quartz, and the lower enclosing rock. From forty seven pounds of the ore 6.5 pennyweights of gold were obtained by amalgamation and evaporation of the quicksilver, giving nearly 14 pennyweights to the one hundred pounds; a result which coincides remarkably with some of those obtained by me.

Mr. Shepherd remarks, that by diligent search, no gold of any importance has been found either eastward or westward of Walton's tract.

The Culpeper Mine, belonging to the Culpeper Mining Company.

The mine is situated eighteen miles west of Fredericksburgh, upon the river Rapidan, a few miles above its confluence with the Rappahannock. The tract is stated to contain five hundred and twenty four acres, of which about two hundred are in forest; a fair proportion of the woodland is covered by pine and oak trees, of large size, and excellent quality; the oak affords timber of the best kind for machinery, and the pine, (chiefly of the red heart kind—most of it being heart,) is admirably fitted for the construction of the buildings. This species of pine is understood to be confined to a small portion of country. The rest of the forest-growth is fitted for fuel and other common purposes.

The soil of the tract, like that prevailing, generally, through the gold region of Virginia, is thin.

The surface is varied; the portion nearest to the great public road, leading to Culpeper Court House, is nearly level: that upon and near to the river is formed in fine undulations, with hills which rise one hundred and thirty feet above the Rapidan, and afford great facilities for mining. These hills are similar to others on the opposite side of the river; and they, with the intervening vallies—the woodlands—the cultivated fields and the stream, form striking features in a varied and beautiful landscape. While the river Rapidan affords most abundant hydraulic power, for mills of every description, and washes the entire boundary line of the tract on one side—a considerable rivulet or branch called Patrick's Run, passes through the land, furnishing every facility for washing the ore, and even considerable resource for machinery.

The buildings, of every description, are of a better construction than are generally found at the gold mines; with scarcely an exception, they are framed substantially, and clap-boarded; there are houses for the miners and laborers, besides inferior cabins: there is a good blacksmith's, shop and store-room adjoining; an ore-house properly secured—a magazine for powder and other valuable things, situated on a high point, at once conspicuous and completely detached, and in all the arrangements, attention has evidently been paid to the morals and decent manners, as well as to the comfort of the people. There are two ore-yards faced with substantial stone walls, and properly levelled: they are, of course, contiguous to the principal adits or mouths of the mine.

The hydraulic power, already mentioned, will soon be turned to great account, by the various constructions now in great forwardness. The entire river Rapidan, here about three hundred feet wide and three feet deep—is raised by a dam, now nearly finished, near the uppermost point of the tract of the Company. The dam is two hundred and twenty five feet long, besides the abutments, which are one hundred and sixty feet more, making four hundred and twelve feet. The height of the dam is in front nine feet—rising six feet above the water below; the water above the dam is eight feet deep, and below it is three feet.

The object of the dam is to turn the water into a canal which runs along the left bank of the river, for the distance of five thousand four hundred feet—over one mile. This canal, which is already to a great extent excavated, is from eighteen to twenty feet wide at top, and nine feet at bottom, and fitted for a depth of water of seven feet.

The river will be led into it, through a very strong gate-way, supported by a powerful frame-work.

The amount of water-power secured by this canal, is so great, that several mills, in addition to those now in construction, might be driven by it. A saw-mill for the purposes of the mine, is in the course of construction, above two-thirds of the way down the canal; it will be supplied by a lateral cut. The building is forty five feet by fourteen; it will contain one saw, which will cut one thousand five hundred feet of inch plank in a day.

The stamping and amalgamating mills, for which mainly the canal is excavated, are to be contained in a building sixty four feet by thirty, of very strong timber, thoroughly framed. It has a basement story of twelve feet high, substantially built of stone. The water wheel is sixteen feet by nine, and is undershot. It will carry twenty heavy stamps, for crushing the ore, and the number may be doubled. There is room and power enough for Chilian, Tyrolese and Araster mills, if the latter are desired; but, it is intended to annex the simple amalgamating bowls of Mr. Hitz, the skillful machinist, whose work in this mill does him great credit, both for its strength and ingenuity, and it is said that his amalgamating bowls are very effectual, while they are comparatively cheap and simple.

The mining operations are considerably advanced, and are conducted by Mr. Hitz, with regularity and skill. The elevation of the ground into hills, rising, as already stated, one hundred and thirty feet above the river, presents great advantages for drainage, and for working the mines in other respects. There are various shafts formerly excavated by Hempstead and others—most of which, being neglected, have fallen in, or are in a state of dilapidation, so that they require no particular notice.

A capacious shaft is now in the course of being excavated, in the highest part of the hill nearest to the river. Its dimensions are ten feet by four, and its depth is, at present, fifty seven feet: it is sinking, at the rate of two feet a day, and it will continue to descend, until it meets the adits from the opposite sides of the hill entering at its base. The shaft will probably be one hundred and twenty feet deep. At the depth of forty feet, there is a tunnel, branching off on both sides, from the shaft; it is in the whole thirty five feet long, pursuing the course of the vein, which is from eight inches to twenty four, and even to thirty inches wide: the tunnel is timbered, as far as is necessary, and is six feet by two and a half in the clear. The shaft also is thoroughly timbered and planked, and furnished with a good ladder and a strong windlass, rope, and buckets, so as to afford all necessary security. The passage-way, in which the ladder is suspended, is partitioned off from the rest of the shaft. At the bottom of the shaft, the vein is from six to fifteen inches wide. In each of the two hills in which the mining operations are carried on, there are two adits. Beginning with the hill nearest to the river—at or near its base, and about twenty or twenty five feet above the level of the river, an adit has been opened into the hill, with the intention of communicating with the shaft already described. This adit is well timbered and planked, so as to be perfectly secure: the planks are two inches thick and the dimensions in the clear are six feet by two and a half; its length at present is one hundred and twenty three feet, and it is increasing at the rate of three feet per day—varying however with the hardness of the rock. There are two cross-cuts in the adit intended for exploration, and they serve also as a refuge for the miners, from the fragments thrown off in blasting: their length is fourteen feet for the one, and twenty eight for the other. The adit is floored with timber and plank, and there is a free passage under it of six inches deep or more, for the discharge of water and for ventilation: this purpose it answers extremely well—the current of air being so strong beneath the floor as to blow out a lighted candle, when placed at its mouth. This mode of ventilation is so effectual, that an adit can (in the opinion of Mr. Hitz,) be driven one thousand feet into a hill, without sinking a shaft to meet the level. The adit, just described, is named No. 1, and, as already stated, will be driven in to meet the shaft.

The adit opposite to this, on the other side of the hill, is named No. 2, and is, in all respects, similar to No. 1—except that there is a deviation of the vein, nearly one hundred feet from the mouth of the adit, which causes an abrupt offset of seven feet to the left, where the vein is recovered. The entire length of this adit is, at present, one hundred and seventeen feet, and when finished, it will, like No. 1, strike the shaft common to the two adits, forming one continued communication, which will completely perforate the hill, and afford a passage through, from side to side. The vein in this adit is two and a half feet wide, measured in two places. In adit No. 1, the vein was less perfect, being divided into strings or ramifications. From No. 1, about four hundred bushels of ore had been taken. The ore at the shaft and at the other adits, was not estimated, but its quantity was very considerable. Adit No. 3, is carried into Hempstead's hill: its mouth is immediately opposite to that of adit No. 2, and it is separated from it only by a small branch of water: it is in fact a continuation of the two adits 1 and 2. No. 3 is, in form and cross dimensions, like the others; it is one hundred and fourteen feet long; it is very strongly timbered with oak posts and two inch plank. Adit No. 4, is on the southeast side of this hill, and its course is at right angles to No. 3: it enters at a lower level, probably twenty or twenty five below, and, like No. 3, is intended to strike Hempstead's old shaft on the top of this hill, and near its centre, which shaft may be opened again.

In addition to the adits already described, another has been opened, a little to the northwest of No. 3: it is called the dust-vein, as the ore is obtained from it in a powdered state, at least in part. This adit has been, as yet, driven only a few feet into the hill—but it discloses a vein about six feet wide, which is found to be rich in gold. This appears not to be the entire breadth of the vein: there is an additional mass of quartz in place, by the side of this adit, and not yet excavated, which is four feet wide—making a vein in the whole, (with the addition of the dust vein of which it appears to be a part,) ten feet wide. This vein is doubtless a distinct one from that in which adits No. 1 and 2 are excavated. Of these veins we are sure, and probably others will be hereafter disclosed. There can be no reasonable doubt, that the knobs and other fixed masses of quartz observed in numerous places, here and there, on the tract, are parts of *veins in place*, and that the loose fragments of quartz which are scattered in profusion, upon various parts of the ground, are attributable to a similar origin.

The main vein, hitherto worked in this tract, appears, in some places, prone to divide into strings: sometimes several, perhaps not longer than a finger, proceed parallel, or nearly so, being separated only by portions of the slaty rock: their separation appears, in general, to be only temporary; for the greater part, they again converge, and unite in a main vein, and the gold is observed to be more abundant in these strings than in larger veins. There is much iron accompanying the ore of gold. It imparts a red color, more or less intense, and the pulverized quartz is almost always red or brown. There is here an iron ore regarded by some as a hydrated oxide. It appears to have proceeded from the decomposition of iron pyrites, which, in many places, are still found fresh and brilliant; in other instances, splitting, rusting, and undergoing decomposition, the result of which is, that a portion of this mineral passes off in the form of sulphate of iron or copperas, which water easily dissolves, while a large portion remains in the form of a vesicular and corroded dark brown or red oxide. So far as this ferruginous matter contains gold, it is doubtless derived from the iron pyrites, which appears to be more or less auriferous, and when it is decomposed, the gold, being insoluble either in the water or in the sulphuric acid which is generated, remains mixed with the oxide of iron, that constitutes the residuum. There is, in some cases, a gradual passage from the brilliant yellow pyrites into this brown or black iron ore.

The strata found in this tract, are varieties of slate and of various other rocks, frequently associated with this primary family. They are remarkable for being placed in a position, nearly or quite perpendicular: the strata stand on edge, or if inclined, they form but a small angle with a vertical line, and consequently, nearly or quite, a right angle with the horizon.

This position of the rocks is very advantageous to the working of the mines, because, the veins of auriferous quartz, being laid between the layers and strata of the rock, are therefore, like it, nearly or quite perpendicular—consequently, the working of the vein creates a vertical adit, in which the miners can stand erect, and when it is wrought quite to the surface of the ground, the opening will be a perpendicular fissure, of easy access.

The direction of the strata by compass, here conforms to the general geological structure of the gold region, and of the continent, being about N. by E. and S. by W.

That the gold region of Virginia, although of very unequal value, is, on the whole, rich in the precious metal, admits of no doubt. It appears also, from satisfactory evidence, that much gold has been already taken, from this vicinity, on both sides of the Rapidan river. Gold is obtained in probably all the branches. Hempstead gathered from the hill and chiefly from the shaft which bears his name, in 1831 and '32, about $4,000, and nearly $3,000 of this was obtained in sixty days: he was aided by only two men, two boys, and a two-ox team, and his excavations were not very considerable. Large sums have been taken from tracts on the opposite side of the river. Ten branches that were examined on this bank, all afforded gold; and out of about one hundred washings, almost all were successful. On Grimes' land, two or three miles from the river, 12 or $15,000 were obtained; and on Greenwood, not less than $40,000. Judge Coulter, immediately opposite, has taken up 10 or $12,000, and is obtaining more. The greater part of this gold was found by washing alluvial matters. On Greenwood there was a rich yield from a vein, and there are auriferous veins on all the above named tracts.

But the question of deepest interest is, what proportion of gold may be reasonably expected from this mine—from its auriferous quartz and their contents, and from the rocks themselves as far as they bear gold? Mining operations are always, to a degree, uncertain in their results. No knowledge or sagacity can enable us to decide, with absolute certainty, on the proportion of the desired treasure, which lies below; it may diminish—it may increase—it may vanish. In a country whose geological structure is uniform like the region before us—where the veins appear to be subject to little irregularity and to constitute an important and probably an original feature of the rocks, we can discern no reason why their metallic contents, and, in the present instance, why the proportion of the precious metal should diminish. That it is, however, very unequally distributed in the veins is manifest, and therefore a trial made in a single place might afford a result either too discouraging, or too flattering. With a view of avoiding, as far as possible, this source of error, portions of the ore were taken from various places; in the veins at the bottom of the shaft, and at the end of the adits; and also from the heaps that had been thrown out of the mine. From fourteen or fifteen localities, including a great number of specimens and ore of all varieties, portions were knocked from each piece, crushed, ground and sifted: they were then washed in pans in the usual way: gold, in every instance, became visible to the naked eye in consequence of the washing, although little or none could be discerned in the fragments, even with the aid of a good magnifier. The gold, of all the washings, was then brought together and amalgamated with mercury that had been previously distilled; the amalgam was freed from redundant mercury, by straining it in leather; and being then decomposed by heat, so as to expel all the quicksilver, the remaining gold was carefully weighed.

Eleven pounds of the mixed ores, thus treated, gave a little over four grains of gold, which is in the proportion of thirty-seven grains to one hundred pounds, or one bushel of the ore—equalling in value, at the mint price of $4\frac{1}{12}$ cents for one grain—*one dollar and fifty cents.*

Another trial, upon a small number of pieces, gave one grain of gold from five pounds of the mixed ores: this is in the proportion of 82 cents for one hundred pounds of ore.

In still another experiment, ore was taken from a vein considered as decidedly rich, but shewing no visible gold. Two pounds of this ore gave two grains of gold, being the proportion of one grain to one pound—or one hundred grains to one hundred pounds of ore, and in value equal to $4 08.

The average of the two first and lowest trials, gives $1 16 to the one hundred pounds of ore: the average of the three trials is $2 13 to the one hundred pounds of ore.

The average of the two most favorable trials is $2 79 to the hundred pounds. I ought not to omit to state, that from a small quantity, perhaps two ounces of very unpromising fragments, a very rich washing of gold was obtained in my presence, far surpassing the results which I have above reported.

It has been already stated, that from information received from many quarters, respecting the expense of working the mines, it would appear that, in general, it does not exceed 30 to 35 cents on one hundred pounds of ore, and consequently the average trial on the large number of pieces presents a favorable result as regards the prospects of this mine. This is probably the trial which is most to be relied upon, and it was certainly a severe experiment for the mine. It may be regarded as affording as fair an approximation to the real productiveness of the mine as can, at present, be obtained; for the ores were taken from every place in the hills where any diggings had been made, and no allowance was admitted for waste in washing. That this waste was of some moment, appears from the fact, that on washing again the matter which had flowed from the pans, a small portion of gold was, in every instance, obtained, even when the washings were, again and again, repeated, on the successive overflows of the pans.

This fact, always observable in a greater or less degree, in the washing of the gold, deserves to be particularly insisted on here. It is certain that an important proportion of the very fine particles of gold is usually lost in the washings. Those who are expert in this manipulation find, that a fourth, and even a fifth or a sixth washing will yield a valuable portion of fine gold.

This occurs more generally in the pyritical ores in which the gold is imbedded in excessively fine particles. This mass when reduced to fine powder, gives a residuum of oxidized iron, (commonly called black sand,) equal almost, in weight, to the fine gold, the latter being malleable or flattened, while the former, being brittle, remains rounded or angular; in washing this mixture in the pan, the gold generally remains on the upper side of the mass, and is therefore more liable to be washed off by the slightest ripple of the water. On the other hand, when the gold is imbedded in quartz ores, especially those with fine fractures, called in Virginia sugar ore—more properly granular quartz,* the gold being of a similar form, is more quickly disengaged, and appears in larger grains. On the contrary, the ferruginous grains or iron sand are so fine as to be scarcely visible, and are invariably found at the bottom of the mass or residuum, and therefore, as well as on account of their greater weight, are much less liable to be carried off by the ripple of the waters. In the purer quartz ores, ordinary care in the use of the pan will recover, at the first washing, a much greater proportion of the gold than in the other case, where repeated and careful repetition of the washings will never fail to give an additional yield. Hence arises the necessity of a different mode of operation upon the two kinds of ores; a view which a regular chemical essay would doubtless sustain.

---

* See the preceding account of the Moss and Busby mine.

There is, therefore, no doubt that the result stated above is below the truth, as regards the quantity of gold; and still it would be better to calculate upon returns rather less than more, in relation to the operations in the large way. In estimating the actual results of the mining operations in the gold region, those concerned will of course take into view the interest of capital laid out in the purchase of the gold lands. On this point, I am not called upon to express an opinion.

Were it possible, however, it would be very desirable to extinguish the spirit of speculation which is producing a dangerous excitement in the public mind, equally hostile to the true interests of the mining region, and of the country, and dangerous to individuals. It would be very desirable that the mines should be purchased only by those who intend to explore them, and not by those who buy merely that they may sell again, perhaps at a very short period, and for a price suddenly advanced, not in consequence of actual returns from the mines, or of a reasonable prospect that they will soon be realized, but because the community is in a state of unnatural excitement.

Virginia has, in her territories, great mineral treasures; but they are to be obtained only by sober industry and skillful application of knowledge and capital; nor would all her hidden treasures of gold, if brought to light, form any adequate compensation for the abandonment of her agriculture and the substitution of a spirit of wild speculation.

The comparatively deep explorations of the Culpeper mines have probably developed, in a good degree, their real character, and there is therefore not so much danger of error as in those cases where the mining has been less thorough and less extensive.

This mine possesses also important advantages, in consequence of its great water power, and the favorable form of the ground, which will enable it to obtain a profitable return, not to be realized, in an equal degree, by a richer mine without similar advantages. It is not believed that this mine will need the application of steam power, certainly not for a long time, because the water can be drawn from the excavations either by gravity, or by machinery connected with the hydraulic power of the mills; and it is expected, even, that its superfluous force, that which is beyond what its own exigencies may require, will in the course of some time, be applied to aid the operation of the mines in the vicinity, not possessing hydraulic power.

In my investigations in the case of the Culpeper mine, and of other mines in the gold region of Virginia, I have received the able and zealous assistance of Mr. Forrest Shepherd, whose minute acquaintance with the topography and peculiarities of this portion of the country, and whose knowledge of the sciences, which have a bearing on this subject, qualify him for extensive usefulness in this department of service, and justly entitle him to confidence.

Gold Districts of the Virginia and New England Mining Company, in Louisa County.

This tract, recently belonging to Mr. William Walton, contains 193¼ acres, and joins to the rich gold tract described above, and now the property of the Virginia Exploring and Mining Company, except that a narrow tract, called the Triple Fork, intervenes, which tract belongs to the Goochland Mining Company. This tract, which is about two hundred yards wide, does not differ materially from that of the Virginia Exploring and Mining Company. Like that land, this contains gold, but it has been only imperfectly explored. Two years ago, a shallow excavation was made, and by the use of a rocker, a few pennyweights were obtained each week, amounting in ten weeks to 680 pennyweights in the whole, and it is expected that the work will be resumed.

This tract appears to be a continuation of the same gold region, its geological structure being the same with that of the rich Walton territory above named. Slaty rocks form the common basis of the whole territory, and upon them lies gravel, then clay, and then soil and forest.

This portion of land is intersected by six veins of quartz, three of which appear very distinctly in the public road, one more obscurely, and one of them is believed to be the identical vein* which, near Mr. Walton's house, is very productive of gold;—no reason appears why it should not be equally productive here, but as it has not been opened, this cannot now be positively known, and it must be decided by future exploration.

No thorough investigation has, as yet, been in any way made upon the tract; mining has not been even begun, and only a few imperfect trials have been instituted for surface gold, by washing the gravel and other loose materials. As far as these trials have been made, they decidedly favor the opinion expressed above, as to the nature of

* On the authority of the county surveyor, Mr. Richardson.

the country. Several persons of good character stated to me, that they, by washing, had obtained gold upon this tract; and gold was procured on the lands, under my own eye, by the usual process of digging down to the gravel and washing; Mr. Forrest Shepherd, also, both now and formerly, procured the same result. These facts, taken in connection with the structure of the country, and with the additional fact, that in the immediate vicinity there is a rich gold mine, leave no doubt that this tract belongs to the same gold formation. The important question, whether this land contains gold enough to justify working it by superficial or by mining processes, can be decided only by actual trials. There appears sufficient encouragement to render it proper to expend a reasonable sum in digging into and washing the gravel in numerous places, and in opening the principal quartz veins, here and there, for a few feet or yards in depth.*

Fauquier and Culpeper Counties.

The extensive tracts about to be mentioned, in the counties of Fauquier and Culpeper, amount, collectively, to three thousand or four thousand acres, but in them no considerable explorations for gold have been made. There are no shafts or adits to afford facilities for observation, nor have even the alluvial deposits been, to any considerable extent, examined by the simple operations of the washing pan. It was not in my power to make any attempts of this nature: there were no means at hand for such purposes, nor was it in any way possible for me, at the time, to discharge the duties of the practical miner; I did, however, all that the circumstances of the case admitted.

---

* I have recently seen a letter, dated Nov. 21, 1836, from a master miner on the spot, a man of skill and integrity, with whom I am personally acquainted, stating, that a very rich vein has been discovered upon the land adjoining this tract upon the south, and it is believed that the vein runs through the ground now under consideration. A new vein has also been discovered in the Walton territory, to the west of the main vein; it promises to be good. In support of the opinion that this is probably a valuable gold tract, may be cited all the facts detailed above respecting the Walton Mine, and also those relating to the numerous gold mines and deposits lying in this vicinity in several directions, and at a very moderate distance; these facts it is unnecessary to recapitulate, and their bearing upon the present case is too obvious to require an explanation. It would, indeed, be most extraordinary if this tract, being surrounded by gold, should itself afford none of the precious metal.

I visited and explored the tracts in question, on both sides of the river, after having also examined, to a sufficient extent, the adjacent gold mining estates.

My visit to these grounds was reserved for the last, among a series of examinations of gold mines, and of tracts of gold-producing lands, which occupied me during several weeks, and which carried me through a continued line in the gold region, extending from the Union mine, in Fauquier County, to the mines of Buckingham—about eighty miles.

During these investigations, in which I have been very ably assisted by persons having exact local knowledge, and much acquaintance with the peculiar indications of gold mines in the region in question, I myself acquired the requisite familiarity with the physical features of the country, and a degree of skill in judging of the indications that are important to be observed. My last occupation antecedent to visiting these lands, was in the grounds of the Culpeper Mining Company, on the Rapidan river, which forms the boundary, on one side, of the narrow neck of land included between the river just named and the Rappahannock: this tract does not, at this place, exceed three miles in breadth. The Culpeper mine, as appears from the facts stated above, is one of decided value.

For the same reason that I mentioned the Walton mine and other gold tracts in its immediate vicinity, in connexion with the notice of the lands of the Virginia and New England Company in Louisa County, I name the Culpeper mine here, and also the other mines in the same region,* because their vicinity to this tract makes them, in some measure, a key to the true nature of the territory. I allude to the gold mines that are intermediate between the Culpeper and the present territory, namely, the Rossin, the Cromarty, and the Millbank, all of which, we are assured, are valuable gold grounds, and they form an uninterrupted line of communication to these lands. I visited the Millbank mine, and although I had no opportunities of investigation while there, the favorable opinion entertained by the proprietors of the value of this mine, is sufficiently indicated by the extensive adit which they are now cutting there, preparatory to other still more important operations. The Millbank mine completes the series, beginning at the Culpeper and proceeding N. E. until we

* I am informed by Mr. James Williams, of Fredericksburg, that several places of richer ores have more recently been discovered at the Culpeper Mine.

F. Shepherd.

strike these grounds, which are immediately contiguous. It gives additional strength to this view, that the estates opposite to the Culpeper mine, and lying on the other side of the river Rapidan, are rich in gold.

There can be no doubt, therefore, as to the general nature of this region, and it remains only to inquire whether the peculiar features indicating gold are continued through the territory on both sides of the Rappahannock. To this question the answer is decidedly in the affirmative.

The ranges and strata, like those of the gold-bearing rocks, with their quartz-veins, the same that, with slight variations of appearance, are seen through the gold region, are here conspicuous, passing under the river Rappahannock, and appearing in the lands on both its banks. The same slaty rocks that characterize the gold region elsewhere in Virginia, are seen here; as in many other places, they are highly inclined, and in general, the quartz veins have the same inclination as the strata and layers of rock, and lie between them. On the northeast side of the river, in the Mount Ephraim estate, the veins of quartz are large; their ruins are numerous, and lie in massy piles on the surface, presenting, sometimes, over a considerable surface of quartz, a delicate frosting of minute crystals of quartz, and at other times the crystals are distinct, having perfect forms. In the extensive tract on the southeast side of the river, the veins of quartz are numerous; they are not so large as on the other side, but they are better defined, and often assume a promising appearance, being accompanied by that bright or deep red earth, so commonly seen through the gold regions, and which has probably proceeded from the decomposition of pyrites, so frequent a companion of gold in Virginia.

In answer to the inquiry whether gold has been actually found upon any portion of these tracts, the facts are not numerous, but as far as they go they are satisfactory. We are credibly informed, that gold has been repeatedly found in both territories by washing; my witness is one who himself obtained the gold on the southeast side of the river, and he had the statement respecting the other side from a gentleman resident on the ground, and personally knowing to the facts.

It appears, then, that there is sufficient encouragement to justify an examination of these grounds in the usual way, and that it is decidedly proper to expend a sufficient sum in washing, upon all the branches, and in opening several of the veins of quartz on both sides of the river.

A person accustomed to the indications of gold in this region, would, in the course of a few weeks or months, be able to make up an opinion which might guide future researches or decide the previous question. There is a large tract of low meadow ground on the Mount Ephraim estate, which greatly resembles, in its general features, the grounds that are now profitably washed for gold at the Whitehall mines in Spotsylvania county: this tract ought to be examined by digging to the slate, and washing the gravel lying above it.

There can be no reason to doubt, that both in the washings of the alluvial matters and in the regular quartz veins, gold will be found. It is, however, impossible to predict in what quantity, but as rich disclosures of gold have been made in the immediate vicinity, as these tracts present the peculiar features of the gold region, and as some gold has been found upon them, a favorable result may be reasonably looked for, although nothing but actual trials will give full assurance. These tracts have important natural advantages. A great river, affording unlimited hydraulic power, passes through the lands. Their elevation above the water insures an easy drainage, and there is a large quantity of good timber; all these resources would, in case of actual mining, prove of great importance.

Remark.—In the experiments of a public course of chemistry, I have recently used portions of the gold which I extracted at the Virginia mines; it proved remarkably pure, and gave fine results in every instance in which it was tried.

Art. XI.—*Notice of some facts connected with the Gold of a portion of North Carolina;* in a letter to the Editor, dated Charlotte, (N. C.) June 6, 1831, from Franklin L. Smith, Esq.

Remark.—The publication of this letter, so many years after its date, demands an explanation, which will be given in another way to the writer. To the public it is sufficient to say, that it was called out from the files where it had lain so long, in consequence of the interest excited in the Editor's mind by his recent examination of the gold region of Virginia; and on account of the striking similarity of most of the facts stated in this letter, to those which he there saw, he now concludes to publish it, although at so great a distance of time from its date, believing that the facts are still valuable, and trusting that the author will forgive the delay.—Ed.

TO PROFESSOR SILLIMAN.

Dear Sir—Your letter, directed to the postmaster of this place, was by him handed to me some weeks since, and would have been answered sooner but on account of indisposition, which prevented me from complying with the request therein contained as soon as my own wishes would have dictated. Even now I feel a delicacy in writing upon a subject to which my limited mineralogical knowledge prevents me from doing adequate justice.

Before entering into a statement of the facts connected with the large quantity of gold lately found near this place, and to which your letter of inquiry refers, it will be necessary to premise, that the gold of this section of country is found in three separate and distinct situations, varying essentially, not only in their locality, but in the appearance exhibited by the metal itself, and the minerals with which it is connected.

The first and doubtless the most important situation, both as regards the certainty and continuance of its products, in which gold is found, is that of veins. Here it is found mingled with quartz and slate, (I speak in the common language of the country,) either in crystals of sulphuret of iron, or the sulphuret being apparently decomposed, and an oxide formed in the crevices of the rock, which give it the appearance and designation among the miners of honey-comb. The gold is found in veins, exhibiting peculiar and distinct appearances from that found, secondly, in alluvial deposits. These alluvial deposits, as their name imports, are found in valleys, and no doubt are produced by the washing from the veins of the adjacent hills. This seems probable from the fact, that the adjacent hills are in every instance, when examined, found to contain veins of gold more or less valuable—that the deposits themselves are at various distances from the surface, and that the pieces of gold, when found, whether pure or connected with quartz, always exhibit that peculiar rounded appearance which is produced by the agitation of water.

The third situation in which gold is found, and that which is most surprising, is that of deposits, or, to use the expression of the miners, "pockets," on the tops or declivities of hills. This differs from the first situation in not exhibiting regularly formed veins, and from the second in not showing any appearances of the form of the pieces found therein being produced by the friction of water, the gold, when found in this situation, seeming to be of a crystalline formation. These deposits or pockets are found at different distances from the surface of the ground, varying from a few inches to five feet. In this latter situation was found the large quantity of gold to which it is supposed you make allusion in your letter. I do not now remember the account given in the newspapers, but am led to believe it was somewhat exaggerated, as such is generally the case when new and extensive discoveries are first made. The facts of the case, it is believed, are these. On account of some indications that a piece of land, lying about eighteen miles in a southeast direction from this, contained gold, two persons from Virginia were induced, more than a year since, to purchase it. After some few ineffectual endeavors to find the precious metal, these persons deserted the land and returned to their homes. In the month of April last, while some laborers were engaged in a search for gold on the land, they discovered, on the top of a hill, about two or three feet below the surface, and in a red clay loam, formed it is presumed by the decomposition of slate, an extremely rich pocket of the kind above described. Such was the richness of this deposit, that in a space little if any exceeding three feet square, the workmen in a short time obtained, as I am assured by unquestionable authority, seventy five pounds of gold, one piece alone weighing nine pounds, two ounces, and seven pennyweights. This piece, when first discovered, was wedged in between a formation of quartz and slate, from which position it was with much difficulty removed, without breaking it into smaller pieces. Its shape was nearly triangular, with a base of eight inches, gradually but irregularly decreasing, until it was reduced to a vertex about two inches broad. It measured nearly thirteen inches in length, and was generally about an inch and a half thick, its surfaces exhibiting more the appearance of crystallization than that produced either by fusion or friction of water. When cleansed of the clay which was attached to this specimen of ore, it presented a solid mass of pure gold, except a small piece of quartz near the narrow end, and even this was intersected with numerous and beautiful veins of the precious metal.

This curious and valuable specimen was purchased in this place, by the Chevalier Vincent Riva Finola, superintendent of the English Gold Mining Company, for $1925, and by him forwarded to New York, and thence exported to Paris.

Before concluding, I would mention that the manner of working the different varieties of mines, as above described, are as various as the different situations in which they are found, and the appearances exhibited by the metal when obtained. A large capital is necessarily invested in working the vein mines, as extensive and expensive machinery is requisite to pulverize and wash the ore, to collect and purify the gold. The profits arising from the working of the vein mines, although occasionally not so exorbitant as are obtained from the others, are more sure and continual, as the veins, as far as experience yet has proved, are enlarged as their depth from the surface increases, and being moistened by water the ore is more easily obtained.

The working of the alluvial deposits requires much less capital, the only investment necessary being the price of the land and the hands employed in the labor—the gold in these situations being found in small pieces, generally pure; a small quantity of mercury, if any, is required to collect it; the machinery is extremely simple, and its expense comparatively nominal—many farmers, owning from ten to a hundred slaves, have found it advantageous to engage in the working of these alluvial deposits, as the profits in many instances are considerable, and even should the mine fail, their labor could with but little loss be turned into another channel.

The working of the third class of mines, "deposits or pockets," partakes of all that uncertainty and hope which constitute the attraction and intense anxiety of the gaming table. Whole months of labor may be expended without one particle of gold delighting the anxious eyes of the workman—when unexpectedly his labor may be repaid and his brightest hopes fulfilled by the discovery of a rich pocket, which may raise him from poverty to wealth. But these rich pockets, like lottery prizes and angels' visits, are few and far between, and it is only in the excitement produced by the discovery of some such valuable pocket as the one described in the preceding part of my letter, that prudent persons are apt to engage in their search.

I have thus, sir, in answering your inquiry, been led into considerable detail, but in it I have endeavored to confine myself strictly to points suggested by the inquiry. Indeed, were I to pursue the important subject of gold-mining, as followed even in this section of country, through all the ramifications which naturally suggest themselves to the mind, I might at once prove tedious to you, even if I should not furnish evidence of my inability properly to handle the subject.

Art. XII.—*Notice of the Shad and Shad Fisheries of the River Delaware;* by Samuel Howell, M. D.

(Communicated by Dr. Richard Harlan, of Philadelphia.)

Analogous to the feathered tribes in their periodical migrations, are the shad of our Atlantic rivers; and like some of these, too, as the Rail bird for example, we are as yet ignorant whence they come and whither they go. In this respect they afford a striking illustration of the goodness and design of an all-wise Providence, in making it a law of their nature that they shall thus annually throw themselves within the reach of man, at a season when they are in the greatest state of perfection, and when circumstances render it most convenient for him to appropriate them to his use.

The shad usually make their first appearance about the middle of March; in early seasons, however, they are occasionally taken in February. It is a singular fact that they are caught within a few days as early above the rapids, one hundred and sixty miles from the ocean, as at the lowest fisheries on the river. But although their advance guard would thus seem to move on with such celerity towards their place of destination, the main body evidently pursue their course more deliberately: and it is obvious from the operations of the successive fisheries, that their progress upward is slow, and that they do not move as fast as the tide would carry them, even admitting that they remain quiescent during the ebb. While they work their way slowly against the ebb tide, it would seem that they head about and rather stem the upward drift of the flood. This is proved by the fact that the drift nets or gilling seines, which catch them meshed on their lower side during their ebb drift, have them entangled on the opposite side when drifting upwards with the flood tide. While their general movement is upwards, for their final destination seems to be the clear shallow waters above the tide, their instinct instructs them to loiter by the way to enjoy their appropriate food, with which the turbid fresh waters of the river seem to abound. What this food is, is conjectural; they certainly are not a fish of prey, and their alimentary canal on dissection, discloses nothing but a greenish, earthy slime, which is probably strained through their fringed throats, as they suck in the water; we may fairly infer that their nutriment consists of the mucilage or matters held in solution by the waters. That they find congenial aliment in these waters is obvious from the fact that they increase in fat and flavor the longer they remain in the rivers.

Whether all the myriads of shad which enter the Delaware annually would proceed to its head waters if unobstructed, is quite doubtful. There is some reason for believing, that like some of the migratory birds, they return annually to the parts of the river in which they were bred. How else are we to account for the marked difference observed in the shad taken in the different parts of the Delaware and its tributary streams? Those, for example, which are caught in the creek, are so small and so inferior in flavor to those taken high up the river, as almost to form a distinct variety of fish. The Trenton shad, or those caught at the falls, have, from time immemorial, been proverbial for their superiority in quality as well as size to those taken in the waters below.

It would seem that these fish enter the Delaware in successive "runs," or shoals, and the experience of all observant fishermen goes to prove that these "runs" make their appearance in *ordinary seasons* at definite periods. For example, there is commonly a scattering run from the middle of March to the middle of April. These are, for the most part, small in size, and not remarkable for flavor. From this period to the 25th of April occurs the great run; and this is felt at each successive fishery for nearly a week, if no storm occurs to drive them into deep water; for it is a fact well ascertained, that while in pleasant weather these fish swim near the surface, yet the moment a cold easterly wind commences blowing, they sink so near the bottom that the deepest nets will sweep over their usual grounds in vain. This run generally continues until the beginning of May, after which period the successive shoals that enter the river are small and scattered, until the termination of the season, which is usually about the 20th of June, though by an existing legislative restriction it is limited to the first of that month in the lower waters of the river, and to the tenth in the upper. The distinctness of these different runs, is proved by the appearance of the fish, by their quality, and by the state of roe in the female; those of the late runs being for the most part less forward than those of the great run in April.

The final cause of their annual visit is doubtless to seek a suitable place of deposit for their eggs, which probably require a temperature higher than that of the ocean, for their development; and a safe and appropriate *nursery* for their young during the early period of their existence, when they are of all others the most delicate. After having spawned, the old fish soon disappear. They are occasionally caught indeed in the nets, but they are thin and worthless, and from their attenuated condition, they are called by the fishermen "*racers*." The young fish remain in the river until towards autumn, by which time they have attained the size of small herrings, when they in their turn disappear. They are caught in immense numbers in the weirs, and racks, and baskets which are constructed in the shallow waters above the falls, for the purpose of taking the common river fish, and they are so tender as to be destroyed by the least violence. These contrivances, so destructive to the young fish, have consequently become objects of legislative prohibition.

The destination of these fish, after they quit the fresh water, is unknown. I have never yet met with an authentic account of their having been caught or even observed at sea, nor have naturalists attempted to trace their route through the ocean, as in the case of the herrings. Their term of life cannot be ascertained, but it is fair to infer that they acquire their growth in a year, from the size to which the young attain during their short sojourn in our waters, as well as from the general uniformity of size observed in each of the several runs. Their average weight may be about seven pounds, but individuals are occasionally caught which weigh as high as twelve and even thirteen pounds.

The numbers of shad taken in the Delaware vary in different seasons. Perhaps it would not be far from the truth to estimate them at thirty thousand at each *shore* fishery. Formerly, when fisheries were fewer, the number far exceeded this amount. I have no data by which to estimate the number caught by the *gilling seines*, but from the rapid multiplication of these destructive contrivances it must be very great. The aggregate amount taken annually by the shore seines and the drift nets, is probably not far short of one million five hundred thousand, which at seven dollars per hundred, would be worth upwards of one hundred thousand dollars.

The principal market is Philadelphia; but immense numbers are vended at the fisheries, to which people flock from all quarters in wagons and boats. The writer has known sixty and seventy wagons supplied in a day, (each perhaps taking at least one hundred,) at the Fancy Hill fisheries, six miles below Philadelphia. The great mass are salted like mackerel, and chiefly for domestic use. In the fresh state they are, in the height of their season, one of the most delicious of any of the finny race, and decidedly the best mode of cooking is that called "planking," which consists in nailing the fish to a clean oaken plank, previously heated, and setting it before a brisk fire. By this method the juices of the fish are all preserved. They are sometimes treated like hams, viz. by rubbing them with fine salt, salt-petre, and molasses, and smoked for a few days, and in this way are very superior to those cured with salt alone.

The usual and most efficient method of taking the shad is by means of seines. These however are applicable only to the deeper waters; in the current, viz. above the tide, amongst the shallows, various other contrivances are used to entrap them. Until within a few years there was but one kind of seine used; this varied in length according to the extent of the range, the width of the channel, and rapidity of the tide or current, as the case might be; its breadth being proportioned to the depth of the water but tapering towards the ends. Both margins are connected with a stout line or rope, the one armed with oblong cedar blocks called corks, presenting the appearance of a string of beads, to support the upper margin at the surface of the water, the other being naked, or sometimes rendered more heavy by the addition, at intervals, of pieces of sheet lead to keep it near the bottom. These lines are joined near to each extremity of the seines and are there called the brails, to each of which are attached the ropes by which the net is to be drawn to the shore. Thus constructed, the net is placed on the stern of what is called the seine-boat—a large barge-like boat, long and narrow, and having a sort of platform in the stern, upon which the net and lines are carefully coiled. The boat being rowed to the proper starting place, the line which is to connect the net with the shore is then taken by a part of the crew, called the landsmen, who are posted on the shore at the starting place, and the boat is rowed out into the river, the residue of the land line and the net gradually running off as the boat recedes, until the whole is dropped into the water, the boat gradually rounding to and approaching the shore, so as to give to the net the form of a crescent, the arms of which being in the direction of the current, so as to gather in as many fish as possible during the drift of the seine. On reaching the shore, the boat's crew seize the line connected with the outer end of the net, called the water line, which was also coiled away in the boat, and both divisions of the crew now commence drawing in their respective ends, gradually "dropping down," as it is called, so as to keep "abreast" of the drifting seine, until each is finally brought to land; when the two ends have reached the shore, the fish are completely enclosed. The next process is called landing; to effect this, the men at each end lay hold of the cork and lead lines of their respective ends, and draw them together, pulling as uniformly as possible so as to keep up a simultaneous movement, the lead line of each end being kept near the bottom by a "holder down," as he is called, whose duty it is to press down this line with his foot, allowing it to slip at every pull of the men who are drawing in the net. In this way they soon reach the central part or bag of the seine, when those pulling upon the sunken line necessarily meet, and the contents of the net become enclosed within the small space between its marginal lines; this is called bagging up. It now only remains to transfer the fish into the market-boat, which is effected by means of scoop or hoop-nets—small hand-nets, managed by a single man, and capable of holding about twenty fish, and this is called bailing.

It is an interesting sight to witness these operations during a fine run of shad, when they are occasionally taken in hauls of thousands. To see the water within the seine black with their backs and bristling with their fins—to witness the animation and bustle of the fishermen, and behold their eagerness and anxiety to secure their booty, are circumstances calculated to excite in the spectator of such an enlivening scene, emotions of delight, and cause him to participate with the successful fisherman in all his joy and hilarity. The writer once witnessed the landing of ten thousand eight hundred shad taken at a single haul—the greatest by many thousands ever made in the river Delaware before or since.

The regular shore-nets vary in length from one hundred and fifty to five hundred fathoms. Formerly they were drawn in by manual labor alone. Of late years, however, capstans have been employed to aid in this laborious operation. The number of men required to manage a net varies from fifteen to twenty five. The whole number employed at the Fancy Hill fisheries, including foremen, clerk, market-men, tide-watchers, &c. is nearly one hundred.

Besides the production of such an amount of healthful and delicious food, in quantity generally sufficient to supply the states of Pennsylvania and New Jersey, the fisheries give profitable employment to a great number of men, at a season when their services are not particularly required in agricultural labor. The fisheries, therefore, constitute an important interest to the states bordering on the river, and one that merits the fostering care of their respective legislatures. The importance of this species of property was recognized at an early period of our history, when fisheries were comparatively few, and numerous salutary provisions were enacted, from time to time, in relation to them, whose object was to perpetuate their benefits, and to secure them to their rightful possessors. Amongst others, were those protecting the fisheries from unnecessary interruption by vessels and rafts, which are expressly required to avoid the seines while fishing, and prohibited under severe penalties from anchoring within the fishing range of any of the fisheries. But of late years the legislatures of these states have been so occupied with political maneuvering and management, that they seem to have lost sight of many of the best interests of their respective states, and amongst others of the fisheries; for while they are compelled to pay heavy taxes into the state treasury, in common with other real property, and are subject to several onerous restrictions, which have been artfully imposed upon them, upon the ground of preserving the breed of fish, they have been so far neglected by their legal guardians, that the river has of late been virtually thrown open to common right, and a class of outlaws—men without a local habitation or a name—are now enjoying privileges and rights, without the shadow of benefit to the respective states, which laws and usages from time immemorial had secured to the riparian proprietor. I allude to the gill-net fishermen, who have literally taken forcible possession of the river Delaware, under the plea of its being a common highway, and have virtually dispossessed the lawful owners of the fisheries of property which they considered as secure, and as much their own as their farms. The several right of fishery had been the fruitful source of litigation in this country from an early period of its history; but it had been so long recognized by legislative enactments, and confirmed by the decisions of the highest judicial tribunals, that the question seemed to be finally and incontrovertibly settled. This right too seemed to be effectually secured to the riparian proprietor, by the circumstance that it was necessary, in order to its enjoyment, that a foothold should be had on shore, whereupon to manage the seine and to secure its contents. This, of course, would subject any person who attempted to encroach on the fishing rights of another, to an action of trespass, and consequently operated as an effectual protection. But the ingenuity of man, ever ready to evade restrictions that clash with his interests, has devised a mode of fishing by which all connexion with the shore is rendered unnecessary, and which, although prohibited by statutory enactments, he is able to practice in utter disregard of law or authority. By this method, the net is so constructed as to enlarge or to mesh, as it is technically said, and not to enclose the shad, as is the case with the regular shore nets, already described. The seine used by these *freebooters* is formed with meshes so large that the fish are permitted to pass their heads through, and on attempting to retreat they become entangled by the gills. The twine too of which the nets are made, is so fine that it is not perceived by the fish, until his head is in the toil and it is too late to escape. These nets are kept extended by means of a small boat at each end, across the main channels, and thus extended they are permitted to drift for miles, until they have become loaded, when they are taken into the boats, the fish secured, and they are again stretched off in the river as before. These contrivances are hence denominated drift nets, or gilling seines, and although prohibited by law, yet so lame are its provisions, that it is morally impossible to enforce it, except in cases where the name of the offender can be ascertained. These marauders, therefore, emboldened by the impunity with which they are enabled to carry on their predatory operations, have increased to such an extent as already greatly to depreciate the shore fisheries, and if not checked, they must, ere long, render them worthless.

Art. XIII.—*Formic Acid—remarks upon its utility, together with a correction of Döbereiner's Process and views respecting the theory of its formation;* by Prof. J. P. Emmet, of the University of Virginia.

Every day brings evidence of the success which Chemistry bestows upon its votaries, in closely imitating some of the numerous productions which are generally regarded as being strictly limited to the influence of a vital power. Examples are already too numerous to make it requisite that the opinion should be sustained by their aid upon the present occasion; I shall therefore confine myself to the very striking instance furnished by the subject of this communication.

The *formic acid,* as the name implies, was at first detected in ants. It exists as a peculiar secretion which they emit when provoked, and, at one time, the only mode of procuring it consisted in macerating or bruising these insects in water and afterwards submitting the mixture either to simple pressure, or to distillation.

It is sufficiently obvious, however, that the product must have been both weak and impure. With the formic acid, thus obtained, exists the malic acid; and to separate the latter, as well as to give the necessary concentration, the acids were neutralized by carbonate of potassa, (without excess)—the malic acid then precipitated by acetate of lead, (added only as long as precipitation took place,) and the solution of the formate, thus left, when sufficiently concentrated, decomposed by means of sulphuric acid. Subsequently, distillation was necessary in order to obtain the formic acid itself; yet, even after this, one impurity being substituted for another, (the acetic for the malic acid,) it would become necessary to have recourse to the additional operations of combining the acids with the oxide of lead, and then separating their salts by well managed crystallization, before we could obtain the formic acid free from the acetic.

It is manifest that an acid, with so very limited a source and so many delays accompanying its preparation, was but ill calculated to excite much general interest. Even after Döbereiner had pointed out the mode by which it could be obtained *artificially*, and Wöhler, Liebig and others, had very much extended the list of substances capable of yielding it by this process, there was found to exist much practical inconvenience, and the formic acid still continues to be known to many chemists, only by description. The last specimen which I purchased cost 50 cents per ounce, although its intrinsic value should not exceed 6¼ cents, when proper and obvious precautions are taken in its formation.

To the taste this acid is very nearly as grateful as the best vinegar, and, at the same time, so very similar, that one might be substituted for the other by housekeepers. Most persons would certainly confound them, for even the distinguished chemists, Fourcroy and Vauquelin, not only deliberately published their conviction of the identity, after an experimental inquiry which had this express object in view, but again asserted the same opinion when their first statement was opposed by the experiments of Suerson, who contended that the formic was a distinct and peculiar acid. The acetic and formic acids have an origin very similar, both coming from the same class of bodies, viz. sugar, starch, gum, wood, &c. By a species of destructive distillation peculiar to each, both may be got from these substances *directly*; but the acetic acid does not appear to yield any notable quantity of the formic, by any operations yet known. In addition to the evidence which H. Braconnot has given, that the former one is frequently generated by living vegetables, I will here notice an instance, founded upon my own observation, of a very striking nature. Being lately very much struck with the odor peculiar to the red oak, I applied my lips closely to the transverse section of some fresh cut logs, and, to my astonishment, sucked up with ease a pure and grateful vinegar, sharp to the taste, and so like the best specimens of the acetic acid that distillation could not have improved its qualities. The tree was full grown and sound, and felled in the month of February, about the 6th, and the wood examined as soon as cut. The acetic acid existed most abundantly in the red portion next to the heart.

In some of the arts, where pure acetic acid of medium strength is required, (as in making white lead,) it appears to me that the formic acid might be substituted; for, independently of the fact that the latter may be procured *pure and concentrated by a single distillation* from the same bodies which, *indirectly, and only by an expensive process*, furnish the acetic acid,—their neutralizing powers, are widely different, and the advantage is greatly in favor of the formic acid. The combining proportions being as follows: *acetic acid* 50, *formic acid* 37, it follows that the difference of weight, which amounts to nearly one fourth of the whole acetic acid, would be always available were the formic acid employed for the purposes of saturation.

This acid, however, can never be brought to the same degree of concentration, because, its elements being in such a ratio as to represent, exactly, 2 *atoms oxide of carbon*+1 *atom water*, it readily suffers decomposition when exposed to the influence of sulphuric acid strong enough to remove its constituent water. This, of course, always happens when a formate is decomposed by the commercial sulphuric acid, and nothing can be more characteristic of the presence of formic acid than the *brisk effervescence*, owing to the escape of pure oxide of carbon, whenever the dry formates are heated with oil of vitriol. There is no odor of formic acid. The acetates, on the contrary, as is well known, furnish the strongest and purest acid when submitted to the same treatment. But although this may be regarded as a defect for some purposes, the formic acid, obtained by decomposing its salts, need never contain more than 20 per cent. of water.

To the chemist and pharmaceutist, the formic acid is highly interesting in consequence of its surprising *reducing power;* being, in this respect, superior even to hydrogen. Like the lampic acid, it often promptly revives the noble metals when saline solutions of the latter are made to boil previous to the addition of the acid; but so perfect is the reduction and precipitation when a *formate* of potassa or soda is employed instead of the uncombined acid, that Döbereiner and others have strongly recommended the process, when chemists are desirous of separating the precious metals from the common or more easily oxidizable ones.* M. Göbel has also shown, that by simply combining the oxides with formic acid, and heating the dry salts thus obtained over a spirit lamp, it is easy to procure, in a state of perfect reduction, the metals zinc, copper, cadmium, bismuth, lead, *nickel*, *uranium*, *cerium*, and *cobalt*.†

The mode of action is obvious, and the facility of reduction equally intelligible. The *oxide of carbon*, composing the formic acid, removes oxygen from the metal and becomes *carbonic acid*, generally leaving the reduced matter surrounded by the excess of the former gas. Carbonic oxide, even when completely gaseous, combines freely with oxygen at a dull red heat, as was shown by Davy, and therefore, in the above examples, where these substances have the additional advantage of previous condensation to the solid state, the formic acid must be very superior to hydrogen when the temperature does not much exceed obscure redness. It is, in fact, together with carburetted hydrogen, the great reducing agent in all furnace operations; for the carbon of the fuel, while in its solid state, must be nearly inoperative at all times, and the carbonic acid which appears so abundantly in all such cases, if the reduction of the ore be complete, should never acquire more than one half of its oxygen from the *air* which enters the furnace. Formic acid, it is obvious, will enable the chemist not only to recover the metal, but to determine accurately the quantity of oxygen with which it was combined—whether the oxide be a *per* or *prot*-oxide, the principle is the same—a given weight of it is to be boiled with formic acid *in excess*. The latter being always decomposed by the operation, furnishes carbonic acid, every atom of which contains an atom of oxygen obtained from the metal; and by the same data, when the *oxide is in excess*, the whole of the formic acid being decomposed into a mixture of carbonic oxide and acid, we have only to collect, separate and determine the amount of each of these gases, in order to arrive at a knowledge of the quantity of formic acid that existed in the solution operated upon. If the reduction of the *per*-oxide be complete, the formic acid will be resolved into water and carbonic

* Annales de Chim. Jan. 1833.

† Journal de Pharm. Tome XIX. p. 485.

acid alone, which would simplify the process very materially, but such a result can hardly be looked upon as quite accurate, notwithstanding M. Göbel's strong recommendation, because the formic acid is very volatile, and a portion must, therefore, always escape decomposition.

From what has been remarked upon the decomposition of formates by strong sulphuric acid, it will appear obvious that chemists possess an easy, direct, and certain method for obtaining oxide of carbon, uncontaminated by carbonic acid.

In many operations of pharmaceutical chemistry, great advantage might be taken of the remarkable properties of formic acid; for, by its power of removing oxygen, it is capable indirectly of decomposing *chlorides*, which of course contain not a particle of this element. The fact is shown by the promptness with which, by simple ebullition, it changes *corrosive sublimate* into *calomel*, the process being at once so easy and satisfactory as to have induced Döbereiner strongly to recommend its adoption; and the rationale will be intelligible by referring the result to the combined agency of the chlorine for *hydrogen*, and the oxide of carbon for *oxygen*, both of the elements of water being derived from a portion of this fluid, present at the time, and either existing free, or being a constituent of the formic acid itself.

An agent which can thus promptly act upon metallic solutions, so as to effect reduction, is at once so peculiar and useful to persons engaged in chemical operations, that it only requires to be cheap in order to become extensively employed. This, I am satisfied, may be made the case.

The conversion of the formiate of ammonia into prussic acid, by simple exposure to heat, and the facility with which the latter yields formic acid when under the influence of strong muriatic or sulphuric acid, are peculiarities well worthy of attention, and have been distinctly brought to notice by M. J. Pelouze.* Formate of ammonia has, in fact, the composition, exactly, of an atom of prussic acid, combined with three atoms of water, and, when exposed to heat so as to separate the water, actually furnishes hydrocyanic acid of great strength; but it is not the less remarkable that the same formate of ammonia, even in very large doses, as was shown by M. Künckel, produces no injurious effects upon animals, neither does it occasion the production of Prussian blue. The cyanide of potassium, which

* Annales de Chim. Dec. 1831.

bears exposure to a red heat without suffering decomposition, readily changes into ammonia and formate of potassa, by simply boiling a saturated solution of it in water.

It is known, moreover, to chemists, that oxalic acid, when suddenly heated to about 300°, becomes changed into formic acid mixed with the oxide and acid of carbon and water. More recently, J. Liebig has examined a remarkable acid, composed of the formic acid and the hyduret of Benzule, (oil of bitter almonds,) to which he has given the name of formo-benzoilic.* Indeed, it seems remarkable, considering all circumstances, that formic acid does not more frequently arise from the reaction of organic bodies upon each other, and the more especially as there is some reason to presume, with Liebig, that *oxide of carbon,* like some compounds of carbon and hydrogen, is capable of acting as a radical. Perhaps the reason is, that formic acid contains elements feebly united, and (as has been stated in relation to the metallic oxides) readily seizes upon additional proportions of oxygen, and thus changes into carbonic acid and water.

The following, founded wholly upon a comparison of combining proportions, may be mentioned as some of its most direct relations:

One atom of formic acid may result from	1 atom of oxalic acid	+1 atom of hydrogen.
	1 atom of sugar	+1 atom of carbonic acid.
	3 atoms of sugar	— 1 atom of light carburet of hydrogen.
Two atoms of formic acid, from	1 atom of tartaric acid	+1 atom of oxygen.
	1 atom of malic (or citric) acid	+2 atoms of oxygen.

Also, 1 atom of formate of ammonia from 1 atom of prussic acid+3 atoms of water.

Artificial preparation of formic acid.

I shall now, however, enter upon what must be regarded as the principal object of this communication; namely, a statement of the results of my own inquiry, by which I have arrived at the conclusion that Prof. Döbereiner's views are erroneous as to the mode of forming this acid, and that the principles involved in its production are analogous to, and perhaps equally deserving of notice as, those that relate to the hydric or sulphuric ether.

One part of tartaric acid (or sugar)—one and a half of peroxide of manganese—one and a half of sulphuric acid, diluted with about two and a half parts of water, when well mixed and subjected to distillation, will furnish the formic acid according to Döbereiner's process. In order to diminish the inconvenience arising from the

* Ann. de Chim. Juin, 1836.

frothing of this mixture, and which is exceedingly great, it is directed to add only half the amount of dilute acid at first, and to make use of a retort having five or six times the bulk of the matter to be put into it.

The explanation given by Döbereiner, and other chemists, assigns to the *peroxide of manganese* an agency absolutely necessary for success, viz. that, while it parts with a portion of its own oxygen and combines, as the protoxide, with sulphuric acid, it is enabled by the oxygen thus detached, to convert the tartaric acid (or sugar) into *formic* and *carbonic acids.*

The whole of this explanation is, however, incorrect, as will appear from the following results of my inquiry.

1. The presence of peroxide of manganese, (or any other peroxide,) is not only *unnecessary*, but positively injurious and productive of much inconvenience. It is positively injurious in consequence of the power which all peroxides have of decomposing formic acid, and productive of inconvenience in consequence of the vast amount of carbonic acid which it produces with the formic acid and the carbon, deposited during the operation. The latter is, in fact, the cause of the excessive frothing.

2. Sulphuric acid is not essential. The formic acid was prepared by phosphoric acid as well as by the chloride of tin; and no doubt all other substances, capable of converting alcohol into ether, may be shown to possess the same power. In no case does sulphuric acid, phosphoric acid, or chloride of tin undergo any decomposition, unless incidentally.

3. The formic acid may be procured from almost every kind of vegetable matter that is capable of being promptly blackened by contact with strong sulphuric acid. It *rarely* appears previous to the carbonization,* and *only* when the sulphuric acid possesses a powerful affinity for *water.*

It would appear, from these particulars, that the process for obtaining formic acid artificially is analogous to those operations for converting cotton, ligneous matter, &c. into gum—gum or starch into sugar, and alcohol into ether or olefiant gas, as far as regards

* When the chloride or sulphate of tin is employed, perfect carbonization does not take place, yet the formic acid is generated readily. There is no doubt, however, that some variety of carbon separates at the same time. Sugar, for example, gave a large deposit of a snuff brown color, and resembling in its properties, the *ulmin* of rotten wood.

the integrity of the sulphuric acid; but, in another respect, namely, the abundant deposit of carbon, previous to the escape of the formic acid, the action more resembles what occurs when alcohol changes at once into carbon and olefiant gas. The resemblance is still closer, if, as I suppose to be the case, the agency of the sulphuric acid consists in removing *water*, or its elements, from the organic substances which yield the formic acid when under its influence. I have mentioned that the phosphoric acid may be substituted for the sulphuric. In the experiment to determine this, the absence of the latter acid was accurately proved by muriate of baryta; starch was employed, and the phosphoric acid had the consistency of syrup. But although important for the investigation, as a fact, the substitution really cannot, in practice, be made with advantage, because the phosphoric acid has not the same degree of affinity for water, and before the essential action occurs, (well indicated by the separation of carbon,) the organic matter becomes decomposed, more or less, from simple exposure to heat, which thus imparts to the formic acid an unpleasant empyreumatic taste. The same remark applies to the *chloride of tin*.

There is little doubt, therefore, that, under the influence of strong sulphuric acid, gum, sugar, starch, lignine, &c. bear the same general relatio nto *formic acid*, and the latter to *oxide of carbon*, that *alcohol* does to *hydric ether*, and the latter to *olefiant gas* or etherine. Thus,

Sulphuric acid, by subtracting	*Water* from	*Alcohol*—	furnishes	*hydric ether.*
		Sugar, &c.	"	*formic acid.*
	Water from	*Ether,*	"	*olefiant gas.*
		Formic acid,	"	*oxide of carbon.*

By a comparison of combining proportions, it will be seen that this explanation enables us to dispose of all the elements except two of hydrogen.

Thus, by adopting $(C+O+H)$ as the formula for one atom of *sugar;* and, supposing *four atoms* to be the smallest amount involved in the process, we will have $(4\,C+4\,O+4\,H)$, from which subtract $\dot{H}$, or one atom of *water*, (removed by the sulphuric acid,) and we shall have $4\,C+3\,O+3\,H$, which is equivalent to one atom of *formic acid* $(2\,C+3\,O+H)$ together with 2 *carbon*, precipitated, and 2 *hydrogen*, unaccounted for. Again; assuming $(6\,C+5\,O+5\,H)$ as the formula for one atom of *starch*, and subtracting $2\,\dot{H}$, or two atoms of water, removed by the sulphuric acid, the remainder will be equivalent to one atom of formic acid, $(2\,C+3\,O+H)$ together with 4 atoms of carbon deposited, and 2 atoms of hydrogen unaccounted for.

During the preparation of formic acid by Döbereiner's process, as well as by my own, in which no peroxide of manganese is employed, there is always formed, previous to the carbonization, a considerable quantity of *volatile oil*, which, at first, might be considered as arising from the excess of *hydrogen* and carbon in the process; but a special inquiry has convinced me that this is not the case, although the oil is so abundant that it may actually be observed floating in drops down the neck of the retort. When the sulphuric acid is so far diluted as not to carbonize the mixture at the heat of boiling water, little else than this spicy oil passes over by distillation; but as soon as the matter becomes black, its formation ceases, and if we begin at once with sulphuric acid about one half diluted, it does not appear at all; but, instead of it, strong formic acid, without any foreign odor, and quite colorless. This volatile oil would not be regarded as objectionable by many, since it imparts an aroma to the acid like that of cassia or cinnamon, and a taste somewhat similar to that produced by hydrocyanic acid.

The process which I recommend, as having been found the most convenient and perfect, for obtaining strong formic acid, is the following.

Mix together in a glass tubulated retort, equal measures of *water*, *oil of vitriol*, and clean, but unground *rye*, (or cracked maiz)—let them be heated to the boiling point, and, as soon as the mass has become thoroughly blackened, add another measure of water and distill off one measure of formic acid.

By the addition of a further quantity of water, and by fresh distillation, a weaker acid may be obtained, which will answer very well to be added in subsequent operations. Besides being too weak, the product of this second distillation will often contain some *sulphurous acid*, which seldom appears in the first, and never is essential to the process. It occurs in company with oxide or carbonic acid, and may be removed by agitating, for a short time, the *cold* formic acid with peroxide of lead, as recommended by Berzelius.

By employing the whole grain, when small enough, as of rye, wheat, oats, &c. and in the great proportion here recommended, the contents of the retort become too solid to froth up easily, so that the medium sized vessels may be employed. Indeed, still smaller ones may be substituted, by simply allowing water to enter through a dropping funnel at the tubulure, in proportion as it is removed by the distillation.

ART. XIV.—*On the Identity of the Torrelite of* THOMSON *with Columbite;* by JAMES D. DANA, A. M., Assist. in the department of Chem. Min. and Geol. of Yale College.

Read before the Yale Nat. Hist. Soc. Feb. 21, 1837.

IN a late number of the Records of General Science, (Dec. 1836, IV. p. 407,) Dr. Thomas Thomson has proposed a separation of the Columbite of Middletown, in this state, (Connecticut,) from the species heretofore designated by that name, and has denominated the supposed new species *Torrelite*, in honor of our distinguished countryman, Dr. Torrey. He has been led to this result, by the dissimilarity which he appears to have obtained, between the specific gravity, hardness, and composition of a specimen from the above locality, and the same qualities of the Haddam and Bohemian specimens. From an imperfect, and evidently very irregular crystal, he has also deduced a primary form, distinct from that of Columbite. The author of these remarks, having had the pleasure of examining several of the splendid crystals, remarkable for their regularity and brilliancy, afforded by the Middletown locality, would here state what appear to be the obvious deductions from these crystals, respecting the propriety of the above distinction. It should be premised, however, that although the conclusion deduced may differ from Dr. Thomson's, yet considering the apparent rhomboidal form of the only crystal in his possession, and also the other discrepancies which he observed, we must regard his conclusions as a fair deduction from the facts observed.

The identity of the Haddam and European specimens was clearly exhibited by Dr. J. Torrey, by means of figures and descriptions, in the Annals of the New York Lyceum, Vol. I. page 89. The first of the following figures is copied from this article. To facilitate comparison, a representation by Mr. Brooke, of a crystal in his possession, (Fig. 2,) supposed from Bodenmais, in Bavaria, is added. The general forms of these figures are modified rectangular prisms.

Mr. Brooke obtained the following angles:

$P : \breve{o}' = 136^\circ\ 30'$ $\breve{M} : \breve{e} = 156^\circ\ 30'$

$P : \breve{e} = 120^\circ$ $\breve{M} : \bar{e} = 114^\circ\ 30'$

With the reflective goniometer, Dr. Torrey found

$\breve{M} : \breve{e}$ and $\bar{M} : \bar{e} = 157^\circ$ $\breve{M} : e = 129^\circ\ 50'$ $\breve{M} : \bar{e}' = 102^\circ\ 50'$

The angles $\breve{M} : \breve{e}$ approximate sufficiently to prove an identity.

Fig. 1.

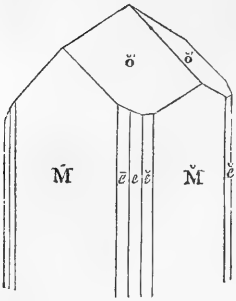


Fig. 2.

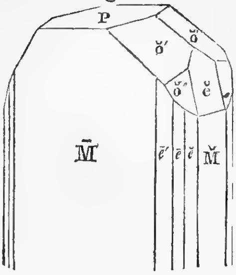
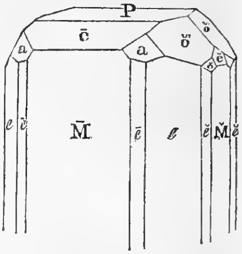


Fig. 3.



1. Haddam, Conn. 2. Bodenmais, Bavaria. 3. Middletown, Conn.

The specimens from the localities that afforded these two crystals are correctly recognized by Dr. Thomson as belonging to the same species. A simple inspection of figure 3, a representation of a Middletown specimen, seems to lead to the same conclusion respecting *its* relation to the Bodenmais Columbite. This will be rendered more apparent by comparing with the above the interfacial angles of this crystal. These angles have been obtained by calculation; they are necessarily founded, however, on previous measurements, with which they very closely agree.*

P : a=126° 2′	a : a (over ŏ′)=102° 58′
P : ŏ′=136° 36′	a : a (over ē)=117° 51′
P : ŏ″=119° 13′	a : a (over *e*)=107° 56′
P : ĕ=119° 40′	ŏ′ : ŏ′=150° 17′
P : ē=160° 34′	ŏ″ : ŏ″=160° 29′
M̆ : *ĕ*=158° 6′	a : ŏ′=156° 20½′
M̆ : *e*=129° 40′	a : *e*=143° 58′
M̆ : *ē*=112° 31′	ĕ : ŏ″=170° 14½′
M̄ : *e*=140° 20′	*e* : *e*=100° 40′ and 79° 20′

In the calculations of these angles, the planes a, were assumed as the faces of the fundamental form. We hence obtain for the values of the crystallographic axes, $a=1.0584=\sqrt{1.12}$, $b=1.206=\sqrt{1.454}$, $c=1$; and by inspection and calculation deduce the an-

* The following values of these angles have been observed by C. U. Shepard. (Shepard's Min. II. 323.)

P : a=127°	M̆ : *e*=129° 30′
P : ŏ′=137° 20′ ?	M̆ : *ē*=112° 10′
P : ē=160° 23′	ŏ′ : ŏ′=149° 30′
M̆ : *ĕ*=157° 40′	a : *e* = 144°

nexed description of the crystal according to Naumann's system of notation:

$$\begin{array}{cccccc} 0P\,. & \tfrac{1}{3}\bar{P}\infty\,. & P\,. & \breve{P}3\,. & 2\breve{P}6\,. & 2\breve{P}\infty\,. \\ \mathrm{P} & \bar{\mathrm{e}} & \mathrm{a} & \breve{\mathrm{o}}' & \breve{\mathrm{o}}'' & \breve{\mathrm{e}} \end{array}$$

$$\begin{array}{ccccc} \infty\bar{P}\infty\,. & \infty\bar{P}2\,. & \infty P\,. & \infty\breve{P}3\,. & \infty\breve{P}\infty\,. \\ \bar{\mathrm{M}} & \bar{e} & e & \breve{e} & \breve{\mathrm{M}} \end{array}$$

A comparison of the above angles, leaves no doubt that this crystal is a specimen of the species Columbite: and we may extend this remark to all the specimens from the same locality; for perfect crystals, affording the same angles, are of frequent occurrence. The crystal figured by Dr. Thomson is so very irregular, that it cannot be considered an exception to this remark. It presents but one replaced lateral edge, and one replaced angle, which sufficiently indicate that little or no reliance can be placed upon its apparent form. According to Dr. Thomson's measurement, M : T (mean of 5 trials)$=84^\circ\ 20'$, T : *e* (plane replacing the acute lateral edge)$=152^\circ$, M : *e*$=110^\circ\ 20'$, a : *e* (inclination of the plane on the angle, to the adjacent lateral edge)$=143^\circ\ 45'$. The last inclination nearly coincides with the interfacial angle a : *e* as above given. This close approximation would authorize a suspicion of the identity of the crystal examined by Dr. Thomson, with the more regular and highly finished individuals so frequently afforded by the locality. The crystals from Middletown, though often minute, occur occasionally of a gigantic size. Prof. Johnston, of the Wesleyan University, has lately described a fractured crystal which originally weighed 14 lbs.* His description is accompanied with a figure of the larger fragment into which it was broken. Its weight was 6 lbs. 12 oz. avoirdupois, and in length and breadth it exceeded seven inches. Its general form was similar to the above figures, and it presented the faces $\breve{\mathrm{M}}$, $\bar{\mathrm{M}}$, *e*, $\bar{e}$, $\breve{e}$, $\breve{\mathrm{e}}$, and another imperfect plane, which appears to be $\breve{\mathrm{o}}'$.

From the identity in the crystallization, therefore, of the Middletown and Bodenmais specimens, we are compelled to assent to their continued union in the same species. Slight discrepancies in the physical characters, if they actually exist, should not influence the

---

* See this Journal, xxx. 387. The Columbite at Middletown occurs irregularly disseminated in a coarse granite, containing mica and feldspar in large crystalline masses. This feldspar has been quarried for the manufacture of porcelain, and by this means the fine specimens of Columbite which the locality has afforded, have been disclosed. Albite and small quantities of uranite, rutile and apatite are associated with the Columbite.

decisions arising from crystallographic examinations with well defined crystals. I have not, however, found the discrepancy in the specific gravity, noticed by Dr. Thomson. A fragment of a crystal weighing about 52 grains, afforded by one trial 5.95, and by a second, 5.948 for its specific gravity, which is a near approach to that of the Bodenmais Columbite, which is stated at 6.038. Mr. Hatchett obtained, for the American specimen in the British Museum, 5.918. The specific gravity was determined by Dr. T. at 4.8038. There is, however, as stated by Dr. T. a very evident difference in hardness. I have found it to vary from 5 to 5.5. The Haddam and Middletown specimens afford a dark reddish brown, or brownish black streak, and very frequently present the blue, reddish or yellowish tints of the steel tarnish.

The composition of the Bodenmais and American Columbite has been variously stated by different analysts. The following are the results of analyses by Borkowsky, Vogel, Thomson and Wollaston:

	Bodenmais.	Bodenmais.	*Torrelite*, from Middletown, Con.	Bodenmais.	Connecticut.
Columbic acid,	74.0	75	73.90	79.65	80
Protoxyd of iron,	20.0	17	15.65	14.00	15
Protox. manganese,	4.6	5	8.00	7.55	5
Oxyd of tin,	0.4	1	——	0.50	—
Water, . .	——=99 B.	——=98 V.	0.35=97.9 T.	0.05=101.75 T.	——=100 W.

The last analysis by Wollaston, was made with but 5 grains of the original specimen in the British Museum. The results of these analyses are not so widely different as to excite a doubt respecting the correctness of the conclusions from crystallographic considerations.

There is yet much uncertainty with respect to the identity of the *Finland* Tantalite with the species Columbite. Its superior specific gravity, (7.2 to 7.3,) and slightly different composition, seem to require their separation. Gustav Rose, in his Elements of Crystallography,* p. 168, has proposed this separation on crystallographic grounds, and has included, as above, the Bodenmais and "Massachusetts" (Connecticut?) specimens in the species *Columbite*, and those from Finland under the separate name of *tantalite*. It would appear, however, that he was not acquainted with the crystallization of the American specimens; for he arranges the species Columbite

* Elemente der Krystallographie nebst einer tabellarischen Uebersicht der Mineralien nach den Krystallformen. 174 pp. 8vo. with 10 copper pls. Berlin, 1833.

in the Monoclinate system of crystallization, (his Zwei- und eingliedriges Krystallisation-system,) and retains the Tantalite only in the Trimetric system, (his ein- und einaxiges Krystallisation-system.) Mr. Rose however remarks, that the only specimen he has observed which leads to this conclusion, was a large crystal in the Berlin Museum, with faces too uneven to admit of measurement, and concludes by observing that other examinations would be required, to establish the certainty of the above conclusions. This subject, therefore, still remains in doubt, and can be cleared up only by accurate crystallographic examinations. The Tantalite from Finland afforded Berzelius, Columbic acid 83.2, Protoxyd of iron 7.2, Protoxyd of manganese 7.4, Oxyd of tin 0.6 = 98.4.

Art. XV.—*On the Causes of the Tornado, or Water Spout;* by R. Hare, M. D. &c. &c.

In July last, I visited the scene of the tornado, which had in the previous month produced so much damage in and near New Brunswick, New Jersey, and heard it described by various witnesses, and have likewise been edified by the observations made respecting its effects by Professors Henry, Torrey, Johnson, and other sagacious and learned observers, and especially those of my friends, Prof. A. D. Bache and Mr. Espy. Probably in no other instance have the effects of a tornado been so faithfully and skillfully traced, ascertained and registered. Prof. Bache regularly surveyed the path of the devastating agent, and ascertained the bearings of the various bodies prostrated by it, so as to make several accurate plots. From an examination of these, the proximate causes of the changes effected, are those of a vertical current at the centre or axis of the tornado, aud of a horizontal conflux of the air towards that axis from the surrounding space. Some trees appear to have been thrown down on the approach of the hiatus, both directly in front of it and on either side; some fell at right angles, others obliquely to the path. Hence they were found to have a great variety of bearings, but always pointing towards the path. The time of their falling, and consequently the direction agreeably to the observations of Prof. Bache, appear to have been determined not only by the extent of the force to which they were exposed, but likewise by the strength of their roots, or the degree of protection afforded them by other bodies, trees or houses for instance. On these accounts, neighboring trees, falling at different times, had different bearings; but that they all fell towards the point occupied by the axis of the tornado at the time of their overthrow, appears to be consistent with the facts. In one instance, both Prof. Bache and Mr. Espy observed that the post of a frame building, being dislodged from the stone on which it rested, was first moved towards the path of the tornado in one direction about eighteen inches, marking its course by a furrow in the ground, and afterwards moved in another direction, nearly at right angles to the former, leaving a similar indication of the course in which it had moved. Intermediately between the time when the tornado bore in those directions, the frame was protected by a house.

While the phenomena above described sufficiently indicate the existence of a horizontal conflux of the air, that of a vertical force was demonstrated by the transportation of the debris of the houses and trees, as well as lighter bodies, to a great distance. A lady's reticule was carried seven miles from New Brunswick, and a letter twenty miles. The piece of timber, technically called the plate, on which the rafters of the roof of a church in New Brunswick rested, was carried nearly a quarter of a mile, and lodged in some trees beyond the Raritan. The fields, on the other side of that river, were strewed with shingles torn from the houses in the town.

After maturely considering all the facts, I am led to suggest that a tornado is the effect of an electrified current of air, superseding the more usual means of discharge between the earth and clouds in those sparks or flashes which are called lightning. I conceive that the inevitable effect of such a current would be to counteract within its sphere the pressure of the atmosphere, and thus enable this fluid, in obedience to its elasticity, to rush into the rarer medium above.

It will, I believe, be admitted, that whenever there is sufficient electricity generated to afford a succession of sparks, the quantity must be sufficient, under favorable circumstances, to be productive of an electrical current; and that light bodies, lying upon one of the electrified surfaces, may be attracted more or less by the other.

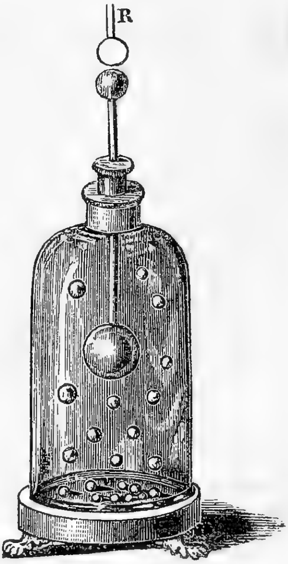
The phenomena of the rise and fall of electrified pith balls, called electrical hail, sufficiently justify this last mentioned statement; while the continuous stream is illustrated by the electrical brush, or the blast of air produced by a highly electrified point.

It will also be conceded, that thunder and lightning are caused by discharges of electricity between the earth and clouds, analogous to those of a Leyden jar or pane; the air performing the part of an electric in place of the glass, while the cloud acts as a coating.

It follows that the phenomena above mentioned as liable to arise between oppositely electrified bodies, may be expected to take place between the clouds and the earth, with effects as much exceeding those produced by human agency, as the snap and spark of an electric battery are exceeded by thunder and lightning. If in the one case pith balls and other light bodies are lifted; in the other, water, trees, houses, hay-stacks and barns may be powerfully affected.* If from a point electrified by a human contrivance, a blast of air is induced; it is assuredly not unreasonable to ascribe to the analogous electrical apparatus of nature, aided by the elasticity of the air, a vertical hurricane. It was under the well founded impression that lightning may be superseded by a current, that we have been instructed by Franklin, to surmount our lightning rods by metallic points, by which electrical discharges from thunder clouds are expected to be conveyed to the earth gradually, which might otherwise pass in sparks of lightning of a formidable magnitude.

If, then, it be demonstrated that a continuous discharge of electricity may become the substitute for lightning, and that within the sphere of the discharge the air may be so lifted as to counteract its

* This figure affords an illustration in miniature of the rise and fall of bodies situated between oppositely electrified surfaces, which, in the gigantic operations of nature, are conceived to be the exciting cause of the tornado. The phenomena represented by it are designated in Pixii's catalogue as "grelé electrique," and may be thus explained. A metallic rod supports one ball within the bell glass, another without, so as to be in contact with the knob of another rod R, proceeding from the conductor of an electrical machine in operation. The brass ball being by these means intensely electrified, attracts some of the pith balls which lie upon the metallic dish in which the bell is situated, and which should communicate with the cushions of the machine. As soon as the pith balls come into contact with the electrified ball, becoming similarly excited, agreeably to the general law they recede from each other and are attracted by the oppositely electrified dish. Reaching the dish, they attain the same electrical state as at first, and are, of course, liable to be attracted again.



gravity; it is in the next place only necessary to advert to facts perfectly well known, in order to point out a cause of acceleration sufficient to account for the well known violence of the tornado.

At the height of fifteen miles, the air has been ascertained to have less than one thirtieth of the density of the stratum next the earth. Of course this substratum would exercise a force nearly equal to the atmospheric pressure, or about fourteen and a half pounds to the square inch, in order to attain the space occupied by the rare medium, to which allusion has been made. It follows that if the weight of the superincumbent air were removed or counteracted, that the inferior stratum would rise with explosive violence.

While the air is thus carried upwards by the concurrent influence of electrical attraction, and the reaction of its own previously constrained elasticity, other bodies are lifted, both by electrical attraction, and the blast of air to which it gives rise. Hence houses within the sphere of the excitement are burst by the expansion of the air which they contain, their walls being thrown outwards, and their roofs carried away; while, by the afflux of the atmosphere requisite to the restoration of its equilibrium, trees, houses, and other bodies are thrown inwards towards the vertical current, from before, as well as from either side.

When once a vertical current is established, and a vortex produced, I conceive that it may continue after the exciting cause may have ceased to act. The effect of a vortex in protecting the space about which it is formed, from the pressure of the fluid in which it has been induced, must be familiar to every observer. In fact, Franklin ascribed the water spout to a whirlwind produced by the concourse of the atmosphere to a given point. His hypothesis was, as I conceive, unsatisfactory, because it did not assign any adequate cause for the concentration of the wind, or for the hiatus which was presumed to be the cause. This deficiency is supplied, if my suggestions be correct.

One fact, of which I am myself a witness, cannot be explained without supposing a gyratory force. About six feet of a brick chimney, without being thrown down, were so twisted on the remaining inferior portion, as to be left with its corners projecting.

I have hardly deemed it necessary to advert to the cause of the progressive motion of a tornado, since that would appear evidently due to the current of the atmosphere within which it may be created.

I believe that the electrical excitement which gives rise to atmospheric discharges of electricity, in whatever form they may occur, is usually ascribed to the chemical changes taking place in the atmosphere; especially the formation or condensation of vapor.

Another view of this subject has suggested itself to my mind. It is known that the atmosphere acts generally as an electric, while the earth acts as a conductor of electricity; and since the electric fluid passes through an exhausted receiver with great facility, it results that the rare medium which exists at a great elevation, is equivalent to another conductor. Hence it is evident that there are three enormous concentric spaces, of which that which is intermediate contains an electric, to which the others may act as coatings. When the tendency of the electric fluid to preserve an equilibrium is taken into view, I believe myself justified in the inference, that not only the space occupied by the globe, but the region beyond our atmosphere, or where the air is sufficiently rare to act as a conductor, must abound with electricity. Thus the atmosphere is situated between two oceans of electricity, of which the tension may often be different. Between these electric oceans, the clouds, floating in the non-conducting air, must act as movable insulated conductors; and from the excitement consequent upon induction, chemical changes, or their proximity to the celestial electric ocean, must be liable to be electrified differently from each other, and from the terrestrial electric ocean.

The phenomena of thunder storms may arise, from the passage of electricity from one electric ocean to the other being facilitated by an intervening accumulation of the clouds, or in consequence of discharges from one insulated congeries of clouds to another through the earth.

The aurora borealis may arise from discharges from one ocean to the other of electricity, which, not being concentrated by its attraction for intervening clouds within air sufficiently dense to act as an electric, assumes the diffuse form which characterizes that phenomenon.

Falling stars may consist of electric matter, in transitu between one portion of the celestial electric ocean and another, tending to restore the equilibrium when disturbed. They may, in fact, consist of electric matter, passing from one mass of moisture to another; as it may be imagined that in an expanse so vast, in which the tension is so low, there may be a great diversity as respects the quantity of moisture existing in different parts. Indeed, it may be conceived that at times the clouds, insulated from each other, may make their reciprocal discharges through the region occupied by the celestial ocean.

I have been informed by my intelligent friend, Mr. Quinby, who resided for some time in Peru, at an elevation of fifteen thousand feet above the level of the ocean, that the clouds in that elevated region are far more electric than in the lower country of the same latitude; and that, on this account, it was considered as dangerous, at times, to travel in the "*sierras,*" or table land. Possibly thunder storms are more frequent in warm weather, in consequence of the greater elevation which the clouds then attain, and their consequent approximation to the celestial ocean of electricity.

Consistently with the hypothesis which I suggested in my essay on the gales of the United States, the enduring rains which accompany those gales are attributed to the contact of an upper warm and moist current of air, with a lower current of the same fluid at an inferior temperature, and moving in an opposite direction. It would follow that, on such occasions, the electricity of the upper region would be diffused among the clouds within the upper stratum, without reaching those existing within the lower current. But in such cases neither stratum would be sufficiently insulated and restricted in its extent to transmit the electricity in a concentrated form, or to be liable to the intense excitement necessary to produce a tornado or lightning.

Facts and Observations respecting the Tornado which occurred at New Brunswick, N. J., in June last, abstracted from a written statement made by James P. Espy, M. A. P. S.; by R. Hare, M. D. &c. &c.

The tornado was formed about seven and a half miles west of New Brunswick, and, moving at the rate of about twenty five or thirty miles in an hour, terminated suddenly at Amboy, about seventeen and a half miles from the place of its commencement. It appeared like an inverted cone, of which the base was in the clouds, and the vertex upon the earth. It prostrated or carried off every movable body within its path; which was from two hundred to four hundred yards wide. Trees which were embraced successively within its axis were thrown down in a direction parallel to its path; those on either side always pointing towards some point which had been under its axis. Houses were unroofed, and, in some instances, unfloored; in others, their walls were thrown down outwards, as if burst by an explosion. There are two facts stated by Mr. Espy, and confirmed by Prof. Bache, which demonstrate fully the existence of an hiatus. In a house which was exposed to the vertical influence of the tornado, a sheet was lifted from a bed, and carried into a fissure made in the southern wall, which subsequently closed and retained it. The same result was observed in the case of a handkerchief, similarly fastened into a fissure in the northern wall. In some instances, frame buildings were lifted entire from their foundations. Joists and rafters were torn from a house and thrown down at the distance from it of about four hundred yards, and in a direction opposite to that in which the trees not lifted from the earth's surface were prostrated. Of course lighter bodies, such as shingles, hats, books and papers, and branches and leaves of trees, were carried to much greater distances. There was no general rain, but hail and rain accompanied the fall of the other bodies. The tornado lasted, in any one place, for but a few seconds: the whole of the damage done at a farm having been accomplished, as the farmer stated, while he was passing from the front to the rear of his mansion, so that, by the time that he reached the back door, there was a perfect calm. Meanwhile, his house and barn were unroofed, and all the neighboring trees thrown down. The noise which accompanied the phenomenon was by every witness described as terrific, being best exemplified by the rumbling of an immense number of heavy carriages. Every object in its path was bespattered with mud on the side towards that from which it advanced. Houses looked as if roughcast, and individuals were so covered with dirt as to be disguised.

Some thunder and lightning attended the tornado. Some trees, which resisted the onset, yielded subsequently; and hence were piled upon those which had fallen earlier. The weaker trees were undermost, and pointed in the direction in which the tornado approached; while the stronger were on the top, pointing in the direction in which it moved away.

Four different places were noticed, where all the trees lay, with their summits directed to a common center. In the middle of one of these localities, the house was unroofed, and the handkerchief and sheet were lodged within the fissures in the walls, as already stated. The windows in the same house were all broken, and much of the glass thrown outside. From the evidence, Mr. Espy infers that the apparent height of the tornado was about a mile. He states that there were, on the same day, two other tornadoes, about seventeen miles apart; and of which the nearest was about the same distance from that of New Brunswick. He conceives that the phenomena all concurred to demonstrate an "inward motion from all directions towards the center of the tornado, and an upward motion in the middle." These statements of Mr. Espy are confirmed by Prof. Bache.

One fact of some importance has not been mentioned by Mr. Espy, which was observed by persons who were upon the ground, during or soon after the catastrophe. I allude to the partial withering of the foliage of those small trees or shrubs which, from their suppleness, were like the reed in the fable, neither uprooted nor overthrown. This unpleasant effect was perceptible when I visited the scene. Each leaf was only partially withered. As it would be inconceivable that mechanical laceration could have thus extended itself equably among the foliage, a surmise may be warranted that the change was effected by the electricity associated with the tornado.

Concluding Remarks, by the Author of the Article.

I ought, perhaps, sooner to have acknowledged that I am aware that it has often been suggested that water spouts might be caused by electricity; but the conjecture has not, so far as my information goes, been heretofore supported by any satisfactory explanation as to the mode in which such a tremendous power could arise from that source. That I am warranted in this impression, will, I trust, appear evident from the circumstance that two of the most distinguished among the late writers in the department of science to which the subject belongs, seem to admit, or to demonstrate, their inability to afford any explanation. I allude to Pouillet and Despretz.

In his treatise on meteorology, Pouillet introduces two narratives respecting tornadoes, which were analogous in every essential point to that of New Brunswick. Especially the existence of an hiatus is proved by the allegation that the walls of prostrated houses were thrown down outwards. A laborer was first urged forwards, in the next place lifted, and lastly overthrown.

The learned and ingenious author concludes with these remarks. "Comment cette puissance, quelquefois si prodigieuse, peut-elle prendre naissance au milieu des airs? C'est une question, il faut de dire, à laquelle la science ne peut faire aucune réponse précise. De toutes les conjectures vagues et hasardées, que l'on peut faire sur l'origine de ce météore, la moins invraisemblable est peut-être celle que le regarde comme un tourbillon d'une excessive intensité. Mais une discussion sur ce point nous semblerait prématurée; il faut multiplier les observations, et constater avec plus de précision toutes les circonstances de ces phénoménes."*

All the information respecting tornadoes afforded by Despretz is comprised in the following paragraphs, which I quote in his own words.

"*Trombe.* La trombe se montre en mer et sur la terre; tantôt elle semble sortir du sein de la mer, et s'élève jusqu'aux nuages; tantôt elle descend des nuages jusqu'à terre.

"C'est une colonne d'eau cônique qui tourne sur elle-même avec une grande vitesse; elle a quelquefois jusqu'à plus de deux cents métres de base. Elle est très-commune entre les tropiques: les navigateurs passent rarement près des côtes de Guinée sans en apercevoir plusieurs.

"Les trombes produisent des effets terribles; elles déracinent les arbres, renversent les faibles habitations, soulèvent les voitures, etc.

"On peut se faire une idée des trombes par les tourbillons de poussiére qui se forment tout à-coup, en été, sur les routes, et qui tournent sur eux-mêmes avec une grande rapidité."†

In Nicholson's Journal, quarto series, London, 1797, vol. 1, page 583, there is an interesting account of some tornadoes seen from Nice, illustrated by engravings, by M. Michaud, who appears to consider them as the effect of electricity, and infers that he could produce the phenomenon in miniature by the aid of a machine, as thunder and lightning are by the same means illustrated. This I have found to be erroneous, as far as my experience goes, and from a cause which is, agreeably to my hypothesis, quite evident. I mean the absence of the co-operating influence of the air when emancipated by electric attraction from the confinement arising from its own weight.

The theoretic remarks of Michaud are very brief, and, to me, scarcely intelligible, as he does not inform us in what way he supposes the electric fluid to operate.

I have understood, since I conceived my hypothesis, that Beccaria ascribed water spouts to electricity, but I have not had the advantage of learning by what reasoning he justified his inferences. However, should it appear that I have made, through the want of information, any undue claim to priority, I shall cheerfully do justice to any philosopher whose speculations I may have overlooked.

---

* Elemens de Physique Experimentale et de Météorologie, vol. 2, p. 727.

† Traité Elementaire de Physique, paragraph 656, p. 828, par C. Despretz.

ART. XVI.—*Description of Edwardsite, a New Mineral;* by CHARLES UPHAM SHEPARD, M. D., Prof. of Chem. in the Medical College of the State of South Carolina.

Mineralogical description.—Primary form. Oblique rhombic prism. M on M=95° (common goniometer.) Base oblique from an obtuse edge.

Secondary form. The primary, with the acute lateral edges replaced by single planes inclining to the adjacent lateral faces under 137° 30′ common goniometer.) In very minute crystals, the summits are occasionally surmounted by four-sided pyramids whose faces correspond to the lateral edges of the prism.

Cleavage parallel to the bases sometimes distinct, but more commonly uneven: in the direction of the longer diagonal very perfect. Surface generally not very smooth, but nearly of the same quality on the different faces.

Lustre vitreous to adamantine. Color hyacinth-red. Streak white. Transparent to translucent.

Hardness=4.5. Sp. gr.=4.2 . . . 4.6.

Chemical description.—Alone before the blowpipe, in very thin fragments, it loses its red color, becoming pearl grey with a tinge of yellow, and fuses with great difficulty on the edges into a transparent glass. With borax, in little fragments, it turns white and gradually dissolves, forming a globule which is bright yellowish green while warm, but colorless when cold. When powdered, it is acted upon very slightly, by aqua regia. A small quantity placed on platinum foil and moistened with sulphuric acid, tinged the flame of the blowpipe green.

General observations.—The crystals are rarely above one third of an inch in length by one sixth in breadth. The replacement of the acute lateral edges is deep, imparting to the prism a flattened appearance, except in the case of very minute crystals surmounted by pyramids; these scarcely exhibit any alteration of the primary prism. The terminations of the larger crystals are always incomplete. In some of them, however, the cross cleavage is eminent, in which instances the lateral faces exhibit cross striæ parallel with this cleavage, analogous to certain varieties of Hornblende and Pyroxene. The nearest approximations to the value of the angle of inclination between the base and the prism was 100° for P on M. More perfect crystals, however, are needed than any I have yet seen for deducing the incidence of P to the obtuse lateral edge. The diagonal cleavage is almost as perfect as the corresponding cleavage in Sillimanite. So close is the resemblance between the smaller crystals above alluded to and Zircon, that on first inspection I mistook them for that species.

The Edwardsite occurs disseminated through Bucholzite in gneiss at the falls of the Yantic in Norwich, Connecticut. The Bucholzite is here considerably abundant, forming apparently a small bed through which are dispersed also individuals of red feldspar, black mica, and more rarely small crystals of blue corundum. The variety of Bucholzite is intermediate in the size of its fibres between that of Chester, Conn. (the Sillimanite,) and that found at Chester, near Philadelphia, and denominated Fibrolite.

Having discovered the mineral above described, while occupied along with my colleague, Dr. Percival, in the geological examination of the state, I have thought proper to name it in honor of his excellency Henry W. Edwards, the governor of the state; since the survey was first recommended by his Excellency, and is still in progress under his administration. Its place in the natural arrangement of minerals is obviously within the genus Tungstic Baryte, and its systematic name as hence arising, and connected also with its system of crystallization, will be the *Hemi-prismatic Tungstic Baryte.*

ANALYSES.

Qualitative examination.—28 centigrammes of the mineral, in the state of an impalpable powder, were heated to whiteness in a platina crucible, whereby it lost 1.5 centigrammes in weight. Another portion was treated with sulphuric acid in a glass tube, without occasioning any perceptible corrosion of the glass.

The mineral was next examined for phosphoric acid, of the presence of which a strong indication was mentioned in the chemical description of the species above given. 11 centigrammes of the ignited mineral were mingled with thrice its weight of carbonate of potassa and heated in a platinum crucible for fifteen minutes. The mixture swelled up, became grayish white, porous, and suffered imperfect fusion. Dilute acetic acid was added to the mass: a copious, heavy, reddish white powder remained undissolved. To the clear acetic solution, acetate of lead was added, which occasioned a dense white precipitate. Nitrate of silver produced a copious yellow precipitate in the same solution. A portion of the white precipitate was heated on platinum foil before the blowpipe; it easily suffered fusion, and on cooling crystallized in the form of an irregular dodecahedron. The mineral was accordingly inferred to be a phosphate.

The matter undissolved by the acetic acid was digested for some time with hydrochloric acid. An odor of chlorine was evolved, attended with a very slow solution of the substance, circumstances which, taken along with the color it assumed, led me to suspect the presence of cerium. A portion of the clear solution was withdrawn and evaporated to dryness, after which water was affused and ammonia added. The precipitate occasioned after washing, was digested in oxalic acid, and the solution separated from the undissolved portion. The latter on being ignited and crushed to powder had a tile red color, and was inferred to be nearly pure peroxide of cerium. The solution gave on the addition of hydrosulphate of ammonia a faint black precipitate, which was taken for sulphuret of iron. Another portion of the hydrochloric solution, containing crystals of sulphate of potassa, was set aside for twenty four hours, when a fine white grained deposit had formed on the bottom of the vessel. This deposit was separated, dissolved in hot water, and decomposed by soda. The precipitate was washed and ignited. It had a tile red color, and was regarded as peroxide of cerium, either pure or only mixed with a little zirconia. The solution from which the crystals had been precipitated was tested for yttria by ammonia, but no cloudiness in the fluid was perceived.

Being satisfied by the foregoing experiments that the mineral was essentially a phosphate of cerium, I did not, on account of the scarcity of the substance, carry my examinations any farther previous to entering upon the analysis.

Quantitative examination.—A. 45 centigrammes of the mineral were mingled with two grammes of carbonate of soda, and heated in a platinum crucible nearly to whiteness for an hour. The matter suffered complete fusion, having shrunk into a very compact mass, with a radiating structure and a grayish white color, with occasional tinges of yellow.

B. Water was repeatedly boiled upon the mass, until the whole was removed from the crucible. The alkaline solution was separated from the insoluble matter by means of the filter, and saturated with acetic acid.

C. The acetic solution (B) was evaporated to dryness and water affused whereby flocculi of silicic acid appeared in the solution, which were separated by a double filter, washed, ignited and weighed 0.25 centigramme.

D. The filtered solution (C) was treated with acetate of lead so long as any precipitate went down. The precipitate was separated, washed, and heated to redness. It weighed 68 centigrammes, which consisting of the subsesquiphosphate of lead, is equivalent to 12 centigrammes of phosphoric acid.

E. The undissolved matter from the alkaline solution B, which had a yellowish white color, was digested in hydrochloric acid for several hours, during which chlorine was emitted and the matter which was not taken up changed from yellow to reddish brown. The solution was withdrawn from the undissolved portion and precipitated by potassa with ebullition. The precipitate had a bluish gray color. When washed and ignited, it weighed 15 centigrammes, and had a chestnut brown color.

F. The alkaline solution (E) was rendered slightly acid by means of hydrochloric acid, after which ammonia was added; a white flocculent precipitate appeared. It was separated from the solution by the filter, and after washing was treated with hydrochloric acid, whereby about two thirds of its bulk were dissolved; the remainder was silicic acid. The solution was transferred to a flask and digested for several hours, with excess of carbonate of ammonia, in a mild temperature. That portion of the precipitate which was not taken up by the ammoniacal solution, was separated, washed, and estimated by means of the double filter at 2 centigrammes.

G. The ammoniacal solution from which the alumina was separated (E) being boiled for a few minutes, became milky; but after being evaporated to dryness and ignited in a platinum capsule, the residuum of glucina was too small to be appreciated by the balance.

H. The solution from which the alumina and glucina had been precipitated by ammonia (F) was tested for lime by the addition of oxalate of ammonia. No cloudiness was occasioned by the oxalate. After some hours standing, the solution was treated with phosphate of soda, whereby its transparency was slightly affected.

I. The 15 centigrammes of a chestnut brown powder (E) were digested for some time in hydrochloric acid and finally treated with sulphuric acid. The matter remaining undissolved was separated, washed, and ignited. It weighed 3.5 centigrammes and had the appearance of pure peroxide of cerium. To the acid solution at a boiling temperature, sulphate of potassa was added, and immediately afterwards a little ammonia, but not sufficient to supersaturate the free acid. A fine white grained precipitate instantly appeared, which was taken for subsulphate of zirconia. It was separated, re-dissolved, and precipitated by potassa. The solution from which the subsulphate was separated was then thrown down by potassa, and the precipitate after edulcoration and ignition weighed 8 centigrammes. It possessed moreover the properties of pure peroxide of cerium. We have therefore 11.5 centigrammes peroxide of cerium in the 15 centigrammes, leaving 3.5 centigrammes for the zirconia: and regarding the undissolved reddish brown matter E as peroxide of cerium, which it closely resembled after ignition, the total weight of this oxide from 45 centigrammes of the mineral is 27.4 centigrammes, or 24.53 centigrammes of the protoxide, in which state of oxidation the cerium no doubt exists in the mineral.

The following, therefore, is a summary of the results obtained in this analysis.

	Centigrammes.			
Protoxide of cerium, .	25.44	or	56.53	p. c.
Phosphoric acid, . .	12.00	"	26.66	"
Zirconia, ...	3.50	"	7.77	"
Alumina, ...	2.00	"	4.44	"
Silicic acid, . . .	1.50	"	3.33	"
	44.44		98.73	
Protoxide of iron,	a trace.			
Glucina,	"			
Magnesia,	"			

The phosphoric acid and oxide of cerium are almost exactly in the ratio of one atom of the former to one and a half of the latter. The Edwardsite is therefore a *basic sesquiphosphate of the protoxide of cerium.* In what manner the other ingredients are combined, or whether they are merely accidental, I shall not venture to decide without an opportunity of confirming the proportions here stated by a repetition of the analysis on a larger quantity of the mineral.

Charleston, S. C. January 30th, 1837.

Art. XVII.—*Description of a new Trilobite*; by Jacob Green, M. D., Professor of Chemistry in Jefferson Medical College, Philadelphia.

Calymene Phlyctainodes.*—*Green.*

Clypeo semilunari, lobis inflatis valdè punctulatis, anticè rotundatoco; cauda ——?

I have been for a long time expecting to find among the trilobites of North America, a species analogous to the *C. variolaris*, which is sometimes met with among the fossils at Dudley in England. Its association with the *C. Blumenbachii* at that locality, and the occurrence of that species in such numbers in the transition limestone so extensively spread over the United States, induced the belief that it would sooner or later be discovered in our rocks.

Dr. William Blanding of this city, has recently received from Springfield (Ohio,) a number of very perfect specimens of the *C. Blumenbachii* and other fossils. In this rich parcel I had the pleasure of discovering a fine fragment of the buckler, of a species not very unlike the *C. variolaris* of Professor Brongniart,—Plate I, fig. 3, A,—the original of which came from Dudley, and is said to be now in the collection of Mr. Johnson, of Bristol, (Eng.)

Nearly the whole of the buckler of our species is perfect, in the specimen I have examined. The middle lobe is large, and very prominent: there are no folds or tubercles upon it, as in the *C. Blumenbachii*, or the *C. macrophthalma*, but the whole of its surface, as well as that of the cheeks, is covered with distinct, rounded grains, or warty pustules. The *C. variolaris* is also furnished with a similar structure, but Prof. Brongniart states that the pustulations in that species, are all pierced at their summit with a small hole, like the tubercles on the genus *Cidaris* among the Echini: this is not the case in our species, the tubercles being all imperforate; they resemble exactly in this respect those on the shell of the *Echinus mammillaris* of Lamarck. The whole contour of the cheeks or side lobes of the buckler, cannot be made out from our fragment; they no doubt, however, form spherical triangles; each cheek is divided by a deep groove into two lobes; the portion of the lobe nearest

* Phlyctainodes—from the Greek, for *pustulated.*

the front is rounded and mammillary; the anterior lateral margin of the other lobe on each cheek is lost, but the rest is very perfect. The edge nearest the abdomen runs parallel with the articulations of the vertebral column, and from its inner edge the front of the buckler starts up in high relief. Between the front and the articulations of the back it is quite narrow, but it swells up and enlarges as it proceeds laterally, so as to give to the whole buckler a pentelobate appearance. In the *C. variolaris* the external angles of the buckler have a prolongation down the sides of the abdomen to the sixth articulation: our mutilated fragment will not permit a comparison in this particular, as one articulation of the back is all that remains. There is no appearance of eyes, though there can be but little doubt that these organs will yet be discovered in other specimens. The breadth of the buckler is one inch and a half; and the length, measuring over the front, is the same.

For this highly interesting species, I am indebted to the kindness of Dr. William Blanding, whose indefatigable labors have greatly contributed to illustrate several departments of American natural history. In a note from that gentleman, which accompanied our fossil, he remarks, "It was obtained from the limestone used in constructing the national road, the quarry of which is within two miles of Springfield, Ohio." The limestone is of a light gray color, and the fossil is spangled with little crystalline particles of that mineral.

In Parkinson's Organic Remains, vol. iii. plate 17, figure 16, there is a representation of the anterior portion of the *C. variolaris*, to which Professor Brongniart refers. The following short account of it is given at p. 266, which will enable those who are curious, to compare our species with it. "In this animal, the lobular divisions seem to have very nearly corresponded with those of the Dudley species; but the structure of the head part differs exceedingly from every other species. In this fossil, instead of the appearance of the distinct parts of a face, there are three large round protuberances, the middle being the largest, and all these protuberances are closely beset with small tubercular elevations. These protuberances occupy nearly the whole space of the head, the eyes being placed on the centre of each of the lateral elevations. The matrix of this is a fine white limestone, but I am not able to say where it was obtained."

Asaphus Platypleurus.—*Green.*

Clypeo? corpore convexo; costis latis, planissimis; parte marginali vix membranacea; cauda rotundata.

I have seen the lower portions only of this trilobite, but the characters which they present are sufficiently striking and peculiar to distinguish it from the other species. Ten articulations of the caudal extremity of the animal still remain in a good state of preservation. The middle lobe of the back is scarcely elevated above the plane of the lateral lobes, and as often occurs in the Asaphs; it has a regular conical appearance, the apex of the cone forming the terminal joint of the tail. Two or three of the last articulations in our specimen are somewhat obliterated. The ribs both of the sides and of the middle lobe are broad and very much flattened; their upper surface is entirely smooth, except a slight sulcus near the lower edge of the costal arches. The grooves or furrows formed by the joints are narrow and not very deep. The tail is rounded, and the membranaceous expansion or border which is found in most of the Asaphs, is in this species but very little developed. In one side it is mutilated in our fragment. The body of the animal projects considerably above the rock in which it is imbedded, and is therefore very unlike the depressed forms of most of the Asaphs; indeed, at first sight I took it for a Calymene.

The rock in which the A. Platypleurus is mineralized, is composed of hard, compact, black limestone. A small fragment of another Asaph reposes near the one just described. It may perhaps be the remains of the young of that species, though the ribs are much more rounded. There is also the joint of a small encrinite adhering to one of the costal arches.

I am indebted to my young friend, Dr. R. M. Jackson, for this and some other trilobites found by him in Huntington County, Penn.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Mr. Faraday on the most improved form of the Galvanic Deflagrator, especially as constructed by Dr. Hare.*—More than sixteen years have elapsed since an account was given in this Journal by Dr. Hare of his galvanic deflagrators, and of their great power in proportion to their size in producing intense ignition. Not long after, the experiments of Dr. Hare were with some additions repeated by us, and the results fully confirming the allegations of the inventor were also published in this work. Although Dr. Hare's memoirs and ours with engravings were published in the Annals of Philosophy and Philosophical Magazine, London, yet it does not appear that his deflagrators were imitated in Europe, the old and inferior constructions continuing in general use. It is satisfactory to find from the following abstracts from a paper of Mr. Faraday, that the course of his investigations has led him latterly to consider the deflagrator of our countryman as the most efficient form of a galvanic series. We quote those passages of Mr. Faraday's paper on the subject of the deflagrator which tend to justify our statement.

Alluding to the principles which this distinguished author had considered as established by his investigations, he uses the following language.

"Guided by these principles, I was led to the construction of a voltaic trough in which the coppers passing round both surfaces of the zincs as in Wollaston's construction should not be separated from each other except by an intervening thickness of paper, or in some other way so as to prevent metallic contact, and should thus constitute an instrument compact, powerful, economical, and easy of use. On examining however what had been done before I found that the new trough was in all essential respects the same as that invented and described by Dr. Hare, Professor in the University of Pennsylvania, to whom I have great pleasure in referring it.

"Dr. Hare has fully described his trough.* In it the contiguous copper plates are separated by thin veneers of wood, and the acid is poured on to or off the plates by a quarter revolution of an axis, to

* Philosoph. Magazine, 1824, Vol. LXIII. p. 271, or Silliman's Journal, Vol. VII. See also a previous paper by Dr. Hare, Annals of Philosophy, [second series,] 1821, Vol. I. p. 329. Also Phil. Mag. [first series,] Vol. LVII. p. 289, in which he speaks of the non necessity of insulation between the coppers.

which both the trough containing the plates and another trough to collect and hold the liquid are fixed. This arrangement I have found the most convenient of any, and have therefore adopted it."

Here follows an engraving and description of the deflagrator which the celebrated author constructed agreeably to the principles of Dr. Hare's, after which he proceeds to say—

"Such was the facility afforded by this arrangement, that a trough of forty pairs of plates could be unpacked in five minutes, and repacked again in half an hour; and the whole series was not more than fifteen inches in length.

"This trough of forty pairs of plates three inches square was compared as to the ignition of a platina wire, the discharge between points of charcoal, the shock on the human frame, &c., with forty pairs of four-inch plates having double coppers, and used in porcelain troughs divided into insulating cells, the strength of the acid employed to excite both being the same. In all these effects the former appeared quite equal to the latter. On comparing a second trough of the new construction containing twenty pairs of four-inch plates with twenty pairs of four-inch plates in porcelain troughs, excited by acids of the same strength; the new trough appeared to surpass the old one in producing these effects, especially in the ignition of wire."

We omit here a detail of the ingenious and accurate experiments on which Mr. Faraday's inferences were founded, our object being in this article to quote his conclusions, rather than his premises; and shall accordingly pass on to those portions of his paper in which the former are communicated.

"When ten pairs of the new arrangement were used, the consumption of zinc at each plate was 6.76 equivalents, or 67.6 for the whole. With ten pairs of the common construction, in a porcelain trough, the zinc oxidized was, upon an average, 15.5 equivalents each plate, or 155 for the entire trough.

"No doubt, therefore, can remain of the equality or even the great superiority of this form of voltaic battery over the best previously in use, namely, that with double coppers, in which the cells are insulated. The insulation of the coppers may therefore be dispensed with; and it is that circumstance which principally permits of such other alterations in the construction of the trough as gives it its practical advantages.

"The advantages of this form of trough are very numerous and great. 1st. It is exceedingly compact, for one hundred pairs of plates need not occupy a trough of more than three feet in length. 2d. By Dr. Hare's plan of making the trough turn upon copper pivots which rest upon copper bearings, the latter afford *fixed* terminations; and these I have found it very convenient to connect with two cups of mercury, fastened in the front of the stand of the instrument. These fixed terminations give the great advantage of arranging an apparatus to be used in connexion with the battery *before* the latter is put into action. 3d. The trough is put into readiness for use in an instant, a single jug of dilute acid being sufficient for the charge of one hundred pairs of four inch plates. 4th. On making the trough pass through a quarter of a revolution, it becomes active, and the great advantage is obtained of procuring for the experiment the effect of the *first contact* of the zinc and acid, which is twice or sometimes even thrice that which the battery can produce a minute or two after. 5th. When the experiment is completed, the acid can be at once poured from between the plates, so that the battery is never left to waste during an unconnected state of its extremities; the acid is not unnecessarily exhausted; the zinc is not uselessly consumed; and, besides avoiding these evils, the charge is mixed and rendered uniform, which produces a great and good result; and, upon proceeding to a second experiment, the important effect of *first contact* is again obtained. 6th. The saving of zinc is very great. It is not merely that, whilst in action, the zinc performs more voltaic duty, but *all* the destruction which takes place with the ordinary forms of battery between the experiments is prevented. This saving is of such extent that I estimate the zinc in the new form of battery to be thrice as effective as that in the ordinary form. 7th. The importance of this saving of metal is not merely that the value of the zinc is saved, but that the battery is much lighter and more manageable; and also that the surfaces of the zinc and copper plates may be brought much nearer to each other when the battery is constructed, and remain so until it is worn out: the latter is a very important advantage. 8th. Again, as, in consequence of the saving, thinner plates will perform the duty of thick ones, rolled zinc may be used; and I have found rolled zinc superior to cast zinc in action; a superiority which I incline to attribute to its greater purity. 9th. Another advantage is obtained in the economy of the acid used, which is proportionate to the diminution of the zinc dissolved. 10th. The acid also is more easily exhausted, and is in such small quantity that there is never any occasion to return an old charge into use. Such old acid, whilst out of use, often dissolves portions of copper from the black flocculi usually mingled with it, which are derived from the zinc; now any portion of copper in solution in the charge does great harm, because, by the *local* action of the acid and zinc, it tends to precipitate upon the latter, and diminish its voltaic efficacy. 11th. By using a due mixture of nitric and sulphuric acid for the charge, no gas is evolved from the troughs; so that a battery of several hundred pairs of plates may, without inconvenience, be close to the experimenter. 12th. If, during a series of experiments, the acid becomes exhausted, it can be withdrawn, and replaced by other acid with the utmost facility; and after the experiments are concluded, the great advantage of easily washing the plates is at command. And it appears to me, that in place of making, under different circumstances, mutual sacrifices of comfort, power, and economy, to obtain a desired end, all are at once obtained by Dr. Hare's form of trough.

"But there are some disadvantages which I have not yet had time to overcome, though I trust they will finally be conquered. One is the extreme difficulty of making a wooden trough constantly water-tight under the alternations of wet and dry to which the voltaic instrument is subject. To remedy this evil, Mr. Newman is now engaged in obtaining porcelain troughs. The other disadvantage is a precipitation of copper on the zinc plates. It appears to me to depend mainly on the circumstance that the papers between the coppers retain acid when the trough is emptied; and that this acid slowly acting on the copper, forms a salt, which gradually mingles with the next charge, and is reduced on the zinc plate by the local action: the power of the whole battery is then reduced. I expect that by using slips of glass to separate the coppers at their edges, their contact can be sufficiently prevented, and the space between them be left so open that the acid of a charge can be poured and washed out, and be so removed from *every part* of the trough when the experiments in which it is used are completed.*

"The actual superiority of the troughs which I have constructed on this plan, I believe to depend, first and principally, on the closer approximation of the zinc and copper surfaces;—in my troughs they are only one tenth of an inch apart;—and, next, on the superior quality of the rolled zinc above the cast zinc used in the construction of the ordinary pile. It cannot be that insulation between the contiguous coppers is a disadvantage, but I do not find that it is any advantage; for when, with both the forty pairs of three-inch plates and the twenty pairs of four-inch plates, I used papers well imbibed with wax,† these being so large that when folded at the edges they wrapped over each other, so as to make cells as insulating as those of the porcelain troughs, still no sensible advantage in the chemical action was obtained.

"As, upon principle, there must be a discharge of part of the electricity from the edges of the zinc and copper plates at the sides of the trough, I should prefer, and intend having, troughs constructed with a plate or plates of crown glass at the sides of the trough: the bottom will need none, though to glaze that and the ends would be no disadvantage. The plates need not be fastened in, but only set in their places; nor need they be in large single pieces."‡

---

* Dr. Hare has obviated these difficulties by making one trough to go into another, the whole being cemented while heated by a flambeau of alcohol, so as not only to keep the cement liquid, but also to expel the moisture and air from the pores, which in refrigerating absorb the cement. The cement was made by melting together one part of suet and seven of rosin.

† A single paper thus prepared could insulate the electricity of a trough of forty pairs of plates.

‡ Dr. Hare mentioned in his account of his deflagrator made with copper cases, that he had found a series in which the side edges were exposed deficient of power. He objected to having the cases like those employed by Faraday, open at the sides. His cases were closed at the sides, and open above and below.

2. *Fossil Footsteps in Sandstone and Graywacke;* by Prof. EDWARD HITCHCOCK.

TO THE EDITOR.

Sir—During the last autumn, my attention was excited afresh to the subject of fossil footmarks, in consequence of the discovery of several new localities in the valley of the Connecticut river, both in Massachusetts and Connecticut. I have now found them along that river, a distance of eighty miles, at numerous quarries; and as the result of my recent examinations, I am now prepared to describe fourteen new species—double the number described in my first paper, contained in this Journal for January, 1836. In general they are more distinctly marked upon the rock than those formerly described; and some of them bear in some respects so near a resemblance to the feet of living Saurians, that I have denominated them *Sauroidichnites.* But I have no certain evidence as yet, that any of them were made by four-footed animals, although in respect to two or three species I have strong suspicions that such was the fact. I have sometimes thought they might have been made by Pterodactyles; yet they have in general fewer toes than those described by Cuvier and Buckland.

Within a few weeks past, I have found on the flag-stones in the city of New York, some marks which I suspect were made by the feet of a *didactylous* quadruped, which, like the Marsupialia, moved by leaps. The rock is slaty graywacke, from the banks of the Hudson, between Albany and the Highlands. They are by no means as distinct as the footmarks on the new red sandstone above described; nor do I feel very confident of the correctness of the opinion expressed above; but as I discovered them in several places, both in New York and Brooklyn, and found their appearance similar, I cannot come to any other conclusion at present, than the one just named; although the inference which follows from it, viz. *that quadrupeds existed during the deposition of the graywacke group*, seems too much like a dream not to excite strong doubts as to the correctness of that conclusion.

I had prepared a paper, containing a full account of all the fossil footmarks mentioned above, with numerous drawings, both of these and of the tracks of living birds. Yet I have concluded it will be wiser to delay its publication till I have re-examined some of the localities next summer, should life and health be spared. Yet I take the liberty to subjoin a catalogue of all the species hitherto discovered, according to a more comprehensive arrangement, which further discoveries have rendered necessary. And even the classification which I now propose, will probably require other modifications.

I arrange all the footmarks under the general term

ICHNITES, (ιχνος and λιθος.)

The subdivisions are three.

1. *Tetrapodichnites,* (τετραπȣς, &c.)

*T. didactylus. On graywacke, New York.

2. *Sauroidichnites,* (σαυρος, ειδος, &c.)

*S. Barrattii. Dedicated to Dr. Joseph Barratt of Middletown, its discoverer. Toes, five.

S. palmatus. (Ornithichnites palmatus of my first paper.)

*S. minitans.

*S. polemarchius, (πολεμαρχειος.)

*S. tenuissimus.

3. *Ornithichnites.*

(1.) *Pachydactyli.*

O. giganteus.

O. tuberosus.

*O. parvulus.

*O. parallelus. (O. tuberosus, α dubius of my first paper.)

*O. divaricatus.

*O. cuneatus. Discovered and named by Dr. Barratt.

(2.) *Leptodactyli.*

O. ingens.

*O. robustus. (O. ingens, α minor of my first paper.)

O. diversus.

α clarus.

β platydactylus.

*O. Deanii. Dedicated to Dr. James Dean of Greenfield.

*O. tenuis.

O. minimus.

*O. crassus.

*O. minusculus.

O. tetradactylus.

*O. gracilis.

Those species to which an asterisk is prefixed are new. I have been surprised at the great number of these, and others may suppose me deceived. But I apprehend that I have fallen short of the number of distinct species, rather than exceeded it. Numerous specimens of most of these species are in my collection, which I shall ever be happy to exhibit; and for a reasonable return, I am ready to furnish plaster casts and moulds of my best specimens, colored like the rock, with a few of the specimens in the rocks.

I have given the above summary, chiefly because I have had frequent enquiries on the subject from scientific gentlemen, and because it may be a long time before I shall be prepared to give an account in detail.

3. *Observations on the Aurora Borealis of January 25th,* 1837; by Denison Olmsted, Professor of Natural Philosophy and Astronomy in Yale College.

The 17th of November, 1835, the 22d of April, 1836, and the 25th of January, 1837, have severally been rendered memorable for the occurrence of the Aurora Borealis, in forms and colors more magnificent and splendid, than any others witnessed by the present generation. The first of these has been already noticed in this Journal. (See vol. xxix. p. 388.) It was distinguished for exhibiting, on a grand scale, nearly all the varieties of the anrora ever observed in our climate, including the bank of *auroral vapor* in the North—the *streamers*—the *arches*—the *corona* formed around the magnetic pole of the Dipping Needle—and the *undulations* or Merry Dancers; while the whole were set off by that peculiar display of crimson light, which usually attends the most remarkable displays of the aurora. The second, that of April 22d, was distinguished above all others which I have witnessed for the *auroral waves.* They began to be observed before the end of twilight, and continued nearly all night, following each other with astonishing celerity. My friend Mr. Twining and myself, formed each a separate judgment of the velocity, and agreed in the opinion that the time occupied by a wave in ascending through 45 degrees, was about half a second,—a swifter motion than either had ever observed in nature before. The display of these undulations from half past 11, and onward, was striking beyond conception. Their course was generally upward towards the pole of the dipping needle. The evening of the 8th of May, also, exhibited a well defined bow. The careful observations made at Hartford by Mr. P. W. Ellsworth, when compared with my own, afforded tolerably accurate data for estimating its height. From these it resulted, that its perpendicular elevation above the earth was 160 miles.

The aurora of the 25th of January, was the most magnificent of all. It resembled that of November 17, 1835, in many particulars, but its colors were brighter and more diversified, and its columns arranged with more symmetry around the magnetic pole, supporting a canopy of unrivalled grandeur.

It cannot be doubted, that we are passing through one of those interesting periods when the Aurora Borealis, after having been scarcely visible for many years, returns in unusual frequency and splendor. A number of such epochs are distinctly marked in history, a full and learned account of which, as far down as the year 1731, may be seen in the celebrated work of Mairan, on the Aurora Borealis, which constitutes a separate volume of the Memoirs of the Royal Academy of Sciences at Paris. Under this impression, it is deemed the more important to preserve some permanent record of each remarkable return of the phenomenon. The limits allowed to the present article, however, will permit only a very cursory review of the facts.

The following is a synopsis of the observations made by the writer of this article.

My attention was first attracted to the aurora as early as 6 o'clock, before the twilight was over. At this time, the northern sky exhibited a blush not unlike that of the fairest dawn. This was skirted on the east and west by ill-defined columns of crimson light, which moved slowly from north to south. At 7 o'clock, these began to send up *streamers*, all of which tended, as usual, to a common focus situated a few degrees south and east of the zenith. At ten minutes past 7 o'clock, the *corona* was distinctly formed, embracing the Pleiades, which were nearly at its center, and seemed for a few moments to control its mysterious movements. By the diurnal motion, however, those stars soon moved to the westward; but the common focus, or point of concourse, of all the streamers, held a fixed position in the magnetic meridian, and at or near the pole of the dipping needle, as was the case in the similar exhibition of November, 1835. At three different times during the evening, the corona was dispersed, and as often re-formed; but the position of its center remained nearly invariable with respect to the magnetic meridian. Meanwhile, the twilight of the northern sky had moved slowly southward, its boundary spanning the firmament from west to east in a well defined zone, until it left only a segment of the southern hemisphere, about 30 degrees in altitude. This portion of the heavens, thrown as it was into striking contrast with the illuminated parts of the sky appeared of a dark slate color, and exhibited the interesting spectacle of stars seeming to shine brightly through a stratum of black clouds.

These phenomena played off various interesting evolutions, until fifteen minutes after 10 o'clock ;* when suddenly the meteor rallied all its forces. Innumerable spindles, of silvery lustre, darted from the crimson folds of light that hung around the sky, and all pointed towards the common focus ; and sheets of a thin vapor of mingled white and red, flowed over these, and wreathed themselves around the same point in wavy folds. A universal stillness reigned ; and the ground itself, now covered with snow, which exhibited a delicate rosy tint, contributed to enhance the beauty of the scene. It will be obvious, also, to one that reflects on the position of the principal constellations, at that time, that a large portion of all the brightest of the fixed stars, were assembled on the spot. Sirius and Procyon, Castor and Pollux, Capella and Aldebaran, were arranged around the field in striking array, along with Jupiter and Mars, which chanced to be present on the occasion, and both at the period of their greatest splendor.

So delicate was the auroral covering that the light of the stars was but little obscured by it. The clusters of small stars in the head of Orion, when most enveloped, was still distinctly visible ; and the two planets appeared through a dense mass of red vapor with seemingly augmented splendor. Mars, especially, seemed peculiarly in his element. In these various attributes of grandeur and beauty, the present greatly exceeded all former exhibitions of the aurora ; but there were wanting the auroral waves, or *Merry Dancers*, which made so conspicuous a figure in the great display of November, 1835.

Although the moon was shining in the east, and but little past the full, yet the distinctness of the auroral lights seemed scarcely impaired by it. This is remarkable : perhaps there is not more than one instance on record, when so splendid an exhibition of the aurora was witnessed in the presence of so full a moon.

---

* It appears from the observations made by Prof. Dewey, at Rochester, N. Y., that this return of the aurora was about an hour earlier there than here.

The *Magnetic Needle* was watched attentively by Mr. E. C. Herrick, and was observed to undergo extraordinary fluctuations,—at one time (7h. 41m.) deviating a whole degree westward of its mean position, and at another time, traversing 45 minutes of a degree in two minutes of time. The *Barometer* had previously been subject to uncommon variations. On the night of the 21st, between 11 and 12 o'clock, it stood at 28.70 inches—a depression nearly or quite unexampled at this place. From that time it had risen gradually, and during the aurora, it stood at about 30.1 inches. Its entire range since Dec. 19th, when it was 30.91 has been very remarkable, since its maximum at this place in ordinary years, is rarely above 30.70, and its minimum seldom below 29 inches. Early in the evening of the aurora, the *Thermometer* was at 20° (Fah.) but sunk rapidly, and at 10 o'clock was only 4 degrees above zero, and before morning fell quite to zero.

The *Zodiacal light* was at that time very conspicuous in the southwest, and has continued to the present time, March 7th, considerably brighter than in ordinary years.

From various accounts published in the newspapers, and from numerous private communications obligingly made to the Editor of this Journal, and to the writer, it appears, that this auroral exhibition was seen over a vast extent of country, and preserved, at points very remote from each other, a remarkable uniformity of appearance. Its limits are unknown; but we have already heard of it, in a form of the most imposing grandeur, as far north as Quebec, and other parts of British America to the eastward of that place, and as presenting a spectacle equally rare and beautiful as far south as the Island of Bermuda. Throughout nearly the whole of this wide region, the phenomenon is identified by its crimson light, by its streamers and its arches, by its corona formed in the region of the pole of the dipping needle of each place, and by its return a little after 10 o'clock, after having once nearly faded away.

At *Windsor*, Vermont, the description given by the editors of the Vermont Chronicle, corresponded very nearly to the appearances as exhibited here; but they add, that on the following morning "the mercury stood at THIRTY SIX DEGREES BELOW ZERO,—a more intense cold, by two degrees, than the morning of January 4, 1835, as measured by the same thermometer, with the same exposure." At *Troy*, the same morning, the thermometer was, at 7 o'clock, *fifteen* degrees below zero.

Near *Hartford*, the aurora was observed with much attention by Mr. E. H. Burritt. While his observations corresponded, in general to those made elsewhere, it is somewhat singular that he was able to detect no effect on the magnetic needle. On this point he remarks: "In the early part of my observations, I placed a magnetic needle, of more than common sensibility, in the open air, to test, or rather to *verify*, the magnetic theory of these phenomena. Two assistants and myself watched the needle alternately, for two hours; but without the satisfaction of any evidence that the needle felt, in the slightest measure, the inspiration of the scene. I thought if it had ever betokened any sympathy in the most violent agitation of the Northern Lights, it would now be too manifest to be mistaken. This is the more singular, as the convergent point of all the radii of the aurora, appeared to be not only in the magnetic meridian, but in the elevated pole of the dipping needle produced, viz. 67 degrees from the North pole."

It is remarkable that at a place not more than about thirty miles north of New Haven, the needle should appear to have undergone no fluctuations, while they were so obvious here, as noted in the observations of Mr. Herrick, and were noticed in other places remote from this. Thus, a writer in the *Republican*, a paper published at Annapolis, (Maryland,) observes—"The magnetic needle was very sensibly affected—the needles in all the instruments constantly vibrated in the horizontal arc, and exhibited also, in an unwonted degree, by a vertical motion, the tendency to *dip*. In an excellent compass by Dollond, the needle was drawn down into close contact with the plate. The instrument was then inclined in its position to cause the needle to traverse, and the declination noted at nine o'clock, and compared with the amount the next morning at sunrise. The instrument indicated a difference in declination of *ten degrees!*" The Barometer according to the same writer stood at 30.2 inches, within one tenth of an inch of its height at this place, although Annapolis is distant about three hundred miles.

The accurate descriptions with which several able correspondents have furnished me of the phenomenon, as seen at different places, will afford the means of making some estimate of the height of particular objects; but my limits do not permit me to enter upon it here. Nor can I add at present any thing respecting the *origin* of the Aurora Borealis, except to declare my conviction, that it is not satisfactorily accounted for by any existing theory. In assigning it so hastily to *Electricity*, a quietus was given to all farther attempts at explanation, while yet even the presence of this agent, in any extraordinary degree, has never been proved. *Magnetism* has done more: the auroral vapor is proved to have magnetic properties; but still this fact gives us no information respecting its *origin*. This, I believe, is to be sought for in a source extrinsic to the earth.

4. *Foreign Accounts of the Meteoric Shower of November*, 1836.

In our last number, we published a statement of the observations which had been made in this country, on the Meteoric Shower of November last. We learn that, in consequence of an invitation issued by the French Academy, the same occurrence was extensively observed by the astronomers of Europe, which resulted in a full conviction of the periodical nature of this phenomenon, in accordance with the views of Prof. Olmsted, as expressed in preceding numbers of this Journal. A digest of numerous observations, was laid before the Academy by M. Arago, which was followed by an interesting communication on the same subject by M. Biot. Not having yet received the French journals containing these memoirs, and not having room among our miscellanies for a full notice of them contained in the London Athenæum for January 7, 1837, we restrict ourselves to a few brief extracts.

"I do not conclude from the preceding considerations (adds M. Biot) that the meteors of the 13th of November are certainly caused by the collision and perturbations of the solar nebula with and from the Earth. I neither affirm nor reject this identity; all I have been desirous of showing is, that on the 13th of November the Earth is near the ascending node of the nebula, towards which she directs her course, and soon traverses; that in these circumstances of position and movement, she must certainly act by attraction and collision on the material particles of the nebula, which at that period would be found near the ascending nodes of their orbits, and at an equal distance from the Sun and Earth, or very nearly so, whence would result phenomena coincident in direction and period with the meteoric period of the 13th of November. Lastly, I have remarked, that the usual passage of Mercury and Venus across much more central regions of the nebula, must necessarily have disseminated, and do perhaps still disseminate, innumerable particles into orbits very little inclined to the ecliptic, and directed in all ways; so that the Earth may accidentally meet with them in other points of her course.

"Although these inductions are very evident to myself, and seem to be necessarily derived from the facts, and from the laws of attraction, I only offer them with extreme diffidence, because I know how easy it is to be deceived in such matters by the most probable analogies, which we cannot verify by rigorous calculations. It is scarcely necessary for me to state, that all the circumstances of position, direction, and periodicity, peculiar to the meteors of the 13th of November have been collected and made known by Mr. Olmsted, (of America,) in a very comprehensive and highly interesting work. He attributes this phenomenon to the existence of a great meteoric cloud, circulating round the Sun in an orbit inclined about 7 degrees towards the ecliptic. This is also very nearly the inclination of the solar equator and nebula. In order that this cloud may come in collision with the Earth on the 13th of November, he places it at the same distance from the Sun in its ascending node; but only wishing the collision to take place at this point, he gives it a revolution of six months, in an ellipse, the aphelion of which answers to the node of the 13th of November. This peculiarity, besides being improbable, does not appear to me to be necessary to the hypothesis; for every ellipse sufficiently different from the terrestrial ellipse by its flattened form, or the actual position of its perihelion, would fulfil the same conditions.* Mr. Olmsted, in the addition to his first work, published in 1836, says, that he also thought the phenomenon of 1833 might have some affinity with the zodiacal light; and, as a sign of this connection, he makes the curious remark, that in 1833 the zodiacal light was unusually apparent, much more so than in 1834 or 1835. But he infers, that the meteoric cloud may be precisely this very light, more apparent in November because seen in its aphelion at a lesser distance from the Earth, whilst six months afterwards, about the 10th of May, being come back to the same node, and the Earth being on the other side of the Sun, we see it in opposition at a greater distance, and consequently under a smaller apparent diameter. Now these purely optical variations, which must take place in every position of the Earth, according to the laws of perspective, for a finite

---

* Professor Olmsted does not consider the period of six months as an essential part of his theory, but admits that it may be a year. Thus, in the last number of this Journal, page 394, he observes as follows:—"In the present state of our knowledge on this subject, I regard it as a point open for inquiry, whether it will best accord with all the phenomena of shooting stars, to give to the meteoric body a period of nearly one year, or of half a year."

body seen from different distances, seem to me to be incompatible with the appearance of the zodiacal light, at different periods of the year, as stated by Domenico Cassini, after a long and unremitted series of observations; but I leave this point of discussion to others, and confine myself to thanking Mr. Olmsted for having so carefully collected and stated the evident elements of so curious a phenomenon. The universal interest which M. Arago has obtained for it by publications relative to the voyage of the *Bonite*, will doubtless multiply the characteristic elements of its appearance; and the analogy of these facts, with those which have already occupied M. Valz, of Marseilles, makes us hope, that their affinity with the spots on the Sun, and the possible expansions of the solar nebula, will henceforth be studied with as much skill as correctness."

5. *United States' Gold Mine near Fredericksburgh, Va.*

To those who wish information respecting this valuable mine, the following minutes made on the spot by the editor, (August 30, 1836,) may perhaps be of some use, and the proprietors will, we trust, not consider them obtrusive, since, although they are imperfect, it is believed that they are correct, and may promote the interests of those concerned.

This mine is in Spotsylvania County, twelve miles from Fredericksburgh by the road—fifteen by the river Rappahannock, upon which it lies. The rock is generally a slate, between argillite and mica slate. The new shaft, already sunk down one hundred feet, and to go down one hundred and fifty, is in a very hard rock—almost like a granular quartz, or resembling a siliceous slate, but not so compact; a steam engine is used for draining the mine. *The strata* have a high inclination; on the opposite side of the river they are vertical, and here decline about 30 degrees from the perpendicular. *The surface* of the ground is formed in rounded or rolling hills with large curves and deep valleys watered by streams; still, the country is not mountainous. *The gold vein* is quartz lying between the layers of rock and partaking of its inclination; the thickness of the vein varies from one inch to one foot—two feet, or more; the quartz is compact, but is divided or divisible, like the slate, into rhomboidal fragments.

Condition of the gold.—In metallic spangles and points disseminated in the quartz, often visible to the naked eye; pieces rarely large, and more generally concealed entirely in the quartz.

Other metals.—The sulphuret of iron and of copper, (pyrites,) the sulphuret of zinc, (blende,) the argentiferous sulphuret of lead, (galena)—disseminated, more or less, in the quartz. Probably these sulphurets may be auriferous, as that of iron has been found to be.

* *Quartz vein.*—In clay, opened lately:—the vein is about one foot wide and stands up in the clay like a wall; the decay of the slaty rock has probably formed the clay, while the quartz, being a firmer material, has better withstood the action of time.

Crushing or stamping.—The quartz, with the contained gold, is broken down by vertical stampers moved by steam; or it is crushed by huge iron—shod wheels of wood (Chilian mills) moved by water power.

The amalgamation.—The mercury and the crushed quartz are agitated together in Tyrolese or Hungarian bowls, and the amalgam being decomposed by distillation, the gold is thus obtained and the mercury recovered.

Yield of gold.—In general about one pennyweight of gold to one bushel (100 pounds) of the quartz; the quartz that is in place in the solid rock may not contain quite so much, while that in the quartz standing in the clay affords fully that amount, or more; that is to say, one dollar to the one hundred pounds of quartz.

Product for time.—The greatest yield of this mine is about six hundred dollars per week—the general yield is less.

Pits, tunnels, and adits.—Several. One adit at the depth of forty feet is carried into the side of a hill—one tunnel at the depth of eighty feet—the adit being under the tunnel. Extent of ground four hundred and fifty acres—cost, $150,000, or $333 33 per acre.

Expenditures.—In all $18,000—with an income of $12,000, including land and all: the cost of working is $40 per day.

Number of hands.—Forty to fifty, including ten Cornish miners.

Time of beginning operations.—In 1835.

A communication direct from the President of the United States' Gold Mining Company through Mr. F. Shepherd, informs us, that contemplated operations at this mine are soon to be on a much larger scale; and that already the working force has been trebled for the year 1837.

---

* Too late for the present No. we have received a description of the auriferous quartz veins of this mine; it will appear in the next number.

6. *Culpeper Gold Mine, Virginia.*

Since the printing of the notice of this mine, and of the other gold mines in Virginia in the present number of this Journal, we have received authentic information from an authority entitled to full credit, that every appearance about the Culpeper mine is very favorable to good success. The workings have been much extended, and new explorations have taken place, disclosing rich and increasing supplies of gold.

The stamping and amalgamating works are far advanced upon an extended scale; they are now equal to the exigencies of the mine and will be extended with its progress. Large supplies of ore are on hand, and arrangements are made, or are in progress, to furnish a full supply to the powerful machinery prepared for its reduction. The expenses are kept within moderate limits, and there appears good reason to expect a favorable result of the enterprise.

7. *Geological Reports.*

I. *Report of a Geological Reconnaissance, made in* 1835, *from Washington, by Green Bay, and the Wisconsin Territory, to the Coteau de Prairie, an elevated Ridge dividing the Missouri from the St. Peter's River;* by G. W. Featherstonhaugh, Esq. Doc. No. 333, printed by order of the Senate, Washington, 1836, pp. 168, with two large maps and four plates of illustrative sections and diagrams.

The plan of this report is substantially the same with that of the preceding year. The greater part of this report is occupied by an elementary sketch of geology, with occasional elucidations from geological facts in this country.

The geological narrative begins at the city of Washington, and contains a sketch of facts on the line of the Potomac to Cumberland —then by Bedford in Pennsylvania, to Pittsburgh—by the Ohio to the great lakes, and through them to Green Bay, lake Michigan— thence by the Fox River, lake Winnebago, the Wisconsin, &c. to the Mississippi—up that river through lake Pepin to the falls of St. Anthony and St. Peter's river—thence up that river to its source— thence to the Coteau de Prairie, and back to the Mississippi and St. Louis, by the way of Dubuque's Lead Mines.

In this wide range, the author met with many interesting facts, which are presented in an attractive form, and it is obvious that the adventure, much of which was performed in a bark canoe, and protracted until winter came with deep snow, demanded no small share of hardihood and perseverance.

As Lt. W. W. Mather, late of West Point, who, under the same authority, participated fully in this adventure, is not named in the report, we presume we may therefore expect a distinct account from his own pen.

II. *First Report on the Geological Survey of the State of New York;* pp. 212. Albany, February 10, 1837, being document No. 161, published by order of the State government.

This very important document is introduced by a statement by his Exc. Gov. W. L. Marcy, addressed to the Legislature, and explanatory of the plan and progress of the survey. Communications are subjoined from

1. Dr. John Torrey, in the botanical department.
2. Dr. James E. De Kay, in the zoological department.
3. Dr. Lewis C. Beck, in the mineralogical and chemical department.
4. The Report of Lt. W. W. Mather on the Geology of the first district.
5. The Report of Prof. E. Emmons on the Geology of the second district.
6. The Report of Mr. T. A. Conrad on the Geology of the third district.
7. The Report of Prof. Lardner Vanuxem on the Geology of the fourth district.

Dr. Torrey and Dr. De Kay, not having as yet entered into the fullness of their labors, have given only an outline of their departments. Dr. Torrey is—

1. To prepare a catalogue of all the plants of the state, indigenous and cultivated.
2. To prepare an herbarium for constant reference, including seven sets for the scientific and literary institutions of the state.
3. To prepare a cabinet of all the woods, fruits, roots, &c. of the state.
4. To procure drawings of the most important plants—to be engraved or otherwise preserved.
5. To communicate information to the citizens who may inquire on subjects connected with his department.

6. To ascertain the best methods of destroying injurious plants.

7. To embody in the final report the most useful applications of botanical knowledge to agriculture, &c.

8. To prepare a State Flora—in the most intelligible and useful form.

Dr. De Kay states, that from a hasty estimate, it is supposed "that the various forms of animated nature exist in about the following proportions :

Mammalia, - - - - - - -	60
Birds, - - - - - - -	275
Reptiles and Fishes, - - - -	250
Mollusca, - - - - - -	200
Insects, - - - - - - -	3,000"

The preliminary reports of the state geologists now printed, have a primary reference to those facts that are of practical utility—the more full scientific views being reserved for the final reports.

Dr. Beck's report on mineralogy and chemical analysis presents the ores of iron as forming a primary—probably *the* primary mineral interest of the state. They are numerous, both in kind and locality, and the annexed analyses shew them to be rich : their actual exploration and manufacture is already great, but being still only in infancy, vast results may hereafter be anticipated.

There are valuable deposits of lead, with ores of zinc ; for details we have no room. This department is ably sustained.

Lt. Mather, assisted by Mr. C. Briggs, Jr. reports on the first geological district, including Long and Staten Islands, and all south of the head of Lake Champlain, southwest to the Delaware river, and along the eastern and northern boundaries of Pennsylvania and New Jersey, and the western boundary of the eastern states to the head of Lake Champlain.

Among useful substances—building materials, rocks and clays for brick and pottery, limestones for lime, iron ore, lignite, peat, and shell marl, mineral waters and soils form prominent and important subjects.

The encroachments and changes produced by the sea and the winds along the extensive island-coasts, forming beaches, shoals, spits, &c. and giving rise to land slides, sand, dunes, salt marshes or marsh alluvions, alluvial sandstones, clays, &c. are set forth in an interesting and striking manner, and, along with the erratic blocks, afford fine subjects for theoretical as well as practical geology. We have viewed these scenes with the same interest which they have excited in the minds of the geologists.

Prof. Emmons describes the second geological district, comprising that portion of the state which lies between the St. Lawrence and Lower Canada, and Lake Champlain, down to the great fork of the Hudson, and thence across to the St. Lawrence, thus including the great northwest angle of the state.

Primary rocks are prevalent in this region, with tertiary and transition in certain parts.

The mountains of granite and sienite rise to a great elevation—the highest, *Whiteface*, being nearly five thousand feet above the sea; they form abrupt ridges and defiles, and abound in immense ruins, in vast unbroken forests, in beautiful lakes—often at a high elevation, forming inexhaustible hydraulic fountains, and in metallic ores, especially those of iron. There are mountains of feldspathic rocks, in which the resplendent chatoyant feldspar forms the prevailing mineral. Extensive dykes are numerous here, and the region is highly interesting both in a theoretical and practical view.

A full account is given by Mr. Hall of the iron ores, which are in this region so numerous and rich that their importance, although already realized in many forges, furnaces, and manufactures, cannot be duly estimated for futurity. Prof. Emmons has very properly insisted upon the importance of science in mining, and we fully respond to his views as to the imperious necessity existing in this country for a school of mines, which not only our necessities demand, but our resources now fully justify.

The third geological district comprises the counties east of and contiguous to Lake Ontario, and to its junction with the St. Lawrence—also south of and contiguous to Lake Ontario, pursuing the line of the Erie Canal as far as the counties of Niagara and Erie: this district was assigned to Mr. T. A. Conrad.

The remaining or fourth geological district comprises the remainder of the state, and lies chiefly south of the Erie Canal, extending to the Pennsylvania line south, and west to Lake Erie, the Niagara river and Lake Ontario.

This district was assigned to Prof. Lardner Vanuxem, assisted by Dr. James Eights.

Primary rocks occupy but a small space, comparatively, in the third district, and, excepting stragglers, they are entirely excluded from the fourth.

There are many points of great similarity, and not a few of perfect identity, between these two very important districts. In an agricultural, economical and social view, they are of extreme importance, and not less so are the conclusions so ably and lucidly presented by the gentlemen charged with the examination of these districts.

In passing over them repeatedly in travelling to and fro, in former years, our attention has been arrested by many of the facts set forth by the geologists of these districts; we allude, particularly, to the abundance and antiquity of the organic bodies, and we are forcibly impressed with the momentous importance of the practical, as well as theoretical results to which their observations have conducted them—particularly as regards the geological antiquity of the stratified rocks—the sandstones—the limestone and the slates, depressing them so deep in the series as to preclude the hope of discovering profitable beds of coal in the State of New York, a hope which we believe has never been relinquished. We have no space to display the importance of all the reports and especially of these two districts; they will be attentively studied by American geologists, while they will not neglect to peruse the whole of this valuable document. We are strongly impressed with the vast importance of the geological survey of this State, and with the conviction that it has been confided to able hands. The investigation is one of great responsibility, demanding not only vigor of mind, but extensive knowledge, acquired by the previous expenditure of much time, money and effort. We have therefore from the first, observed, with no small pain, the narrowness of the allotted compensations, still farther diminished by being charged with all personal expenses, and in some cases, they are docked of a few hundreds more, because certain individuals engaged in the survey chanced to have an academic employment, but one not materially interfering with the full discharge of their geological duty.

His excellency the Governor has very properly recommended to the Legislature, the granting of an enlarged compensation—for that now accorded is unworthy the dignity, wealth, intelligence, and high character of the State of New York, and is wholly disproportioned, even in its aggregate, to the vast interests involved; for, the results of this survey will add millions to the resources of this State. Its enlightened Legislature, when they view the whole ground, will doubtless make more ample provision.

These remarks are substantially applicable to other States, not excepting the one where we write, which however possesses not the vast resources of its colossal neighbor. We should not have ventured out of our usual and more appropriate sphere, had we not been long stationed among the watchmen upon the walls of American science, and we are therefore the more unwilling that its merits should be lightly appreciated—unwilling that gentlemen of high character should be left solely or chiefly to motives of patriotism, of benevolence, or of the love of knowledge, for inducements to engage in its more arduous enterprises.

This country is redundant with wealth, increasing beyond calculation; and to this hour, the men who are its pioneers, as regards some of its highest interests, are left with a recompense wholly disproportioned to their talents, their acquirements, their duties, and their responsibility. No men in our country are so inadequately remunerated, except those who have still higher claims—the teachers of religion. On both subjects, the State of New York is well entitled to the honor of leading in a more liberal and righteous career.

III. *Report on the Geological Survey of Ohio, signed by* Dr. S. P. Hildreth, *Chairman*—his associates being *Mr. Riddell, Mr. Lapham, and Dr. Locke.* pp. 187, with diagrams. Columbus, Ohio, 1836.

This report is the result of a reconnaissance of the State of Ohio, under the direction of Dr. Hildreth, whose eminent qualifications for the discharge of this duty have been often made apparent in the pages of this Journal. The prevailing argument with popular legislators, namely, that of utility, in the sense of pecuniary advantage, is fully sustained in this preliminary report. Immense quantities of coal, of iron ore, of limestone, of gypsum, clay, sandstone, marl, and salt are found in Ohio, and in situations exceedingly accessible and favorable for transportation. All this has been abundantly proved by Dr. Hildreth in previous volumes of this Journal; but it was necessary to review the subject and to exhibit it in a lucid and popular form to the legislature and the public. This has been ably done in the report now under consideration, and we cannot doubt that the legislature of Ohio will provide, on a liberal scale, for the expense of the survey, which, however, we must presume, will exceed the estimate of $12,000. It is however easier to obtain additional funds to finish such an undertaking, than it is to obtain an appropriation to begin; and it is not to be presumed that the local government will permit this most important enterprise to fail, or to remain in an unfinished state, especially in the hands of gentlemen of competent knowledge, talent and zeal.

The reports of Mr. Lapham and Dr. Locke, we have not seen, if indeed they have made separate reports. A part of that of Prof. Riddell, but without the illustrations, has come to hand. We have no room for its details, which will in due proportion be embodied in the final report.

IV. *Report on the New Map of Maryland*, 1836. pp. 104, with six large folded maps. In two parts: Part 1, by Prof. J. T. Ducatel. Annapolis, December 26, 1836, on the geology.—Part 2, by J. H. Alexander. Baltimore, February 15, 1837, on the topography and engineering.

The Report of the geologist contains—

Sec. 1. Geological examinations of Calvert county, in reference to its agricultural resources.

Sec. 2. On the present condition of agriculture in Calvert county and the means of improving it.

Sec. 3. Geological examinations made in Ann Arundel county.

Sec. 4. Geological examinations made in St. Mary's, Charles and Prince George's counties.

Sec. 5. Excursion into Allegany county, with preliminary observations on the geology of the country, from the Atlantic tertiary deposits to the bituminous coal region of Frostburg.

Sec. 6. Description of the Frostburg coal-field.

Sec. 7. Description of the maps and sections that accompany the Report.

An introductory view of the geology, &c. of Maryland appeared in this Journal, (Vol. xxvii, p. 1,) and we are happy to see that the outline then sketched, has been so far and so ably filled up by Professor Ducatel, whose own communication on this subject, (which he has encouraged us to expect in a future No.) we will not anticipate by any remarks.

Mr. Alexander's Report on the topography, rail road, and canal capabilities, contains a great amount of exact and valuable information of the greatest importance to the State of Maryland. This Report relates to the Coptank and Transquallin Canal, and to the Atlantic Rail Road.

We trust that the State of Maryland will fully carry out the views of their able engineer, and thus sustain a successful although friendly rivalry with the neighboring states, which are doing so much for the great cause of internal improvement.

V. *Report on the Geological Reconnaissance of the State of Virginia;* by Prof. Wm. B. Rogers, of the University of Virginia. pp. 143; wtth illustrative sections.

This able document, preliminary to a more detailed report, is replete with valuable information, and affords the best assurance of the successful completion of this arduous labor.

Virginia is a fine field for geological observations, as it possesses most of the regular formations that have been found in this country, from the primary to the most recent alluvial. Its tertiary contains inexhaustible resources for agriculture, furnishing the calcareous ingredient of immense deposits of marine shells—while it affords to science many points of interesting comparison with similar deposits in the old world. Its coal fields are rich in the combustible material, and its gold is diffused through a wide region.

It has lead, copper, and iron—sandstone, soapstone, and slates, and mineral waters of great variety, strongly charged with mineral ingredients, and some of them remarkable for an elevated temperature, and for a copious perennial flow. Its great elevated valley of the Shenandoah abounds with ancient fossils, with grand and picturesque scenery, and with modern calcareous deposits in vast caverns. Its natural bridge is one of the wonders of the world. But all appropriate topics will be illustrated in the detailed report—especially "the minute geology, practical and scientific, of all parts of the state.

There will be a geological map, with accompanying sections and profiles, and a cabinet of specimens illustrating the report.

VI. *First Annual Report of* Prof. Henry D. Rogers, *of the University of Penn., State Geologist.* Dec 12, 1836. pp. 22.

This Report gives a preliminary reconnaissance of the state, and assigns the groups of formations and their boundaries. The section lying southeast of the Cumberland Valley is denominated the southeast region. The middle area, stretching northeast and southwest, comprising nearly the whole mountainous zone of the state, embraced between the southeast region and the principal ridge of the Allegheny mountains is called by Prof. R. the Appalachian region, while the mountains west are denominated the Allegheny chain. The observations of the late season have been made principally between the Maryland line and the Susquehanna in one direction, and the Cumberland valley and the ridge of the Allegheny mountains in the other, with occasional excursions to the west of the Allegheny on the one hand, and into the Cumberland valley on the other; comprising an area of six thousand square miles.

In the Appalachian region, useful substances abound, although they are limited in number. Coal and iron ore, of several species, are found, and in inexhaustible quantities; limestone, marl, sandstone and conglomerates, also abound. No metal more precious than iron is found in any considerable quantity.

Although the strata are enormously contorted and broken, having evidently been subjected to great violence, there are no igneous rocks—no dykes of trap or porphyry, and no veins of quartz. We are compelled to omit the detailed description of the strata.

It is expected that the survey and all its attendant labors will occupy five years. This luminous preliminary report gives good assurance that the task will be ably performed, and that much good will result—while there is every reason to believe that the State of Pennsylvania will continue to afford all requisite appropriations.

VII. *First Report of the Geology of the State of Maine;* by Charles T. Jackson, M. D., &c. &c., and Geologist to the State of Maine. pp. 128, with an Atlas, containing twenty four plates.

This report came to hand at the last moment of the present number, but exhausted as are both our time and space, we cannot omit to say that it is a performance possessing the highest order of merit. Some years ago, Dr. Jackson and his friend Mr. Alger published in this Journal, (Vols. xiv. and xv.) a memoir on the Geology of Nova Scotia, &c. with a map. This memoir was afterwards, in consequence of another visit to Nova Scotia, revised and enlarged, and published with graphic illustrations in the Transactions of the Boston Academy; for a notice of it see Vol. xxii. p. 167, of this Journal. We there presented this memoir, *as a model* in its kind. It has certainly not been surpassed, by any similar effort in this country before that whose title is given above.

The present sketch of parts of Maine is a masterly production, and is well worthy of an analysis, both on account of the ability with which it is executed, and of the interesting facts which it announces. This analysis is, however, at this time, entirely out of our power, but we cannot dismiss the subject without a few brief remarks.

Maine is a country chiefly of primary rocks—with a large division of those of transition, and towards New Brunswick it has an important region of the lower secondary. Every where it has alluvial and diluvial deposits, and vast igneous formations, not only in the interior but forming a barrier against the ocean surge, along a considerable part of its immense sea coast, indented as it is by bays and estuaries almost beyond example. Among the mineral formations of Maine, are granite, gneiss, mica and talcose, and other slates, including roofing slate and alum slate; also, soapstone, limestone, and marble—sandstones and brecciated rocks of many varieties; jasper, including the beautiful ribbon variety; lead, zinc, manganese and iron;* greenstone, trap and its varieties, and porphyry. The trap dykes are numerous and exceedingly distinct; they cut through most of the other rocks and produce upon them, most distinctly, those peculiar effects, which to a demonstration prove their igneous origin. Scientific geology is greatly indebted to this survey for some of the most lucid and convincing facts on this head; while the diluvial deposits, the boulders and ruins, the diluvial furrows in the rocks, the sea shells now adhering to and inherent in rocks which once formed the sea coast, although elevated twenty six feet above the sea board, a salt spring at Lubec, and many other topics equally illustrate other parts of scientific geology. Dr. Jackson is entirely master of his subject, as well as of the kindred sciences of mineralogy and chemistry, and his report is remarkable for its lucid clearness and its attractive style.

In mentioning (however briefly and imperfectly) the labors of so many able men, we are forcibly struck with the wide contrast between the present state of geological knowledge in our country and that when in our early pursuits in this science, and its congeners—even so late as the first conception of this Journal, (only twenty years ago,) we could hardly find a glimmering taper to enable us to grope our way through the thick darkness. Now if all is not light, certainly light is breaking in from all quarters, and the time is not distant when we shall become acquainted with the geological resources of the whole of this country, and even the entire continent; and already our native geologists have added much to the stores of geological facts, and to the extension and elucidation of the science itself.

---

* We have never heard of a case of natural magnetism equal to one named in this report, where a bed of magnetic iron ore not only magnetized so powerfully the iron instruments used to break it up as to adhere to them in large tufts of the fragments of the iron ore, but, a crow bar suspended freely over the iron ore takes the position in the magnetic meridian, and thus becomes a true but gigantic needle.

8. *Fire Bricks.*—Mr. Isaac Doolittle, superintendant of Iron Works at Bennington, Vermont, has, from materials found in that vicinity, manufactured fire bricks, which have stood a blast of five months, and being recently examined appeared so little worn that the furnace has again been put in blast.

This discovery appears of serious importance. We have seen specimens of the sand, which is purely siliceous—of the clay, which is of the porcelain family, and of the brick and a crucible made from these materials, all of which appear to be excellent.

In the furnaces they substitute blocks and bricks formed of these materials for fire stones in the construction of hearths, and of tymps for blast furnaces. Heretofore hearth-stones have been obtained from Stafford, Connecticut, but these materials appear preferable to either for durability and cheapness.

9. *Supposed Volcano at Sea.*—An intelligent shipmaster writes from the coast of California, that on his passage out "on Thursday, April 9, 1835, in lat. 7° N. lon. 99° W. we observed some little things floating by the ship, which on examination proved to be *small stones,* resembling pumice stone. From their appearance I should suppose they were of volcanic origin. We sailed upwards of fifty miles through them, thinly scattered over the surface of the sea. We were about five hundred and forty miles from the continent, six hundred from the Gallipagos, and six hundred from Clipperton Rock. The northeast trade winds prevail in these latitudes. I can form no satisfactory opinion whence they came, excepting from some volcanic eruption at the bottom of the ocean. As I send you specimens, you can forward part of them to Prof. Silliman.*

"The meteoric shower in November, 1834, was seen in California."—*Boston Daily Advertiser.*

Volcano at Sea.—We copied into the last Gazette, from the Boston Daily Advertiser, an account of a shipmaster sailing many miles along the coast of California, through floating bodies of small light

* These specimens, forwarded to us by some unknown friend, are decidedly pumice stone, hardly distinguishable from those of the Lipari Islands. Color light gray—structure, vesicular and fibrous, or filamentous—float on fresh water, with half their volume out at first, until they grow heavier by absorption. They destroy the polish of glass, and appear to have been some time afloat, as they are considerably worn by friction: they have a distinctly saline taste. They were undoubtedly the ejections of a volcano.—Ed.

stones, resembling those which are cast out by volcanoes. Capt. Bradshaw, of Beverly, of the ship Lagodan, brought to our office yesterday, a specimen of the same sort of stones, which he picked up on the 27th of April, 1835, in lat. 13° N. lon. 108° W. Capt. B. sailed about twenty miles through these stones, with which the top of the water was thickly covered. It will be seen, by a comparison of the latitudes and longitudes, that Capt. Bradshaw was six hundred miles distant from the place where the stones were picked up by the other ship.—*Salem Gazette.*

10. *Visit to Iceland.*—Extracts from an account of a visit to Iceland, by M. Eugene Robert.—Bulletin de la Société Géologique de France. Tom. vii. Feuilles 1–2.

The siliceous concretions formed by the Geysers of Iceland, cover an extent of four leagues in length, throughout which traces of ancient geysers are numerous. We have hence been enabled to observe this singular formation under all its different forms; passing by insensible shades from a loose friable state, the result of a rapid deposition, to the most compact and transparent. We have not only observed impressions of the leaves of the birch tree, of equiseta and different grasses, but the *branches* of the birch are in many places very distinctly recognizable, presenting much the appearance of our agatized woods. At the present time not one of the plants here occurring, are found on the island, and it may be considered probable that their destruction is owing to the invading silica.

The numerous thermal springs, in the midst of which the Geysers are situated, occupy large valleys in the interior of the island.

Appearances indicate that these waters proceed from deep crevices, in which they have been heated by contact with the volcanic fires. It is worthy of note that the action of the Geysers is never more magnificent than during an inundation of the valley by rain. The rivers proceeding from these springs often resemble milk in appearance, owing to the argillaceous bole which they take up in their passage among the siliceous concretions. Such are the white rivers of Olafsai.

Mt. Hecla, like all the mountains of Iceland, is entirely covered with snow, and not the least smoke appears about its summit. The obsidian found in a rolled state on its side, and tbe pumice stone, form a bed of thirty feet. Fragments of branches of the birch tree occur in the midst of this bed, the remains of the ancient forests of the island which the volcanic eruptions have entirely destroyed.

11. *Storms.*—It appears from the following notice that the mode of investigation by which Mr. Redfield has developed the true character of American storms, has been adopted with success by the meteorologists of Europe.

Meteorological Society, Dec. 13.—Dr. Birkbeck, President, in the chair. Several highly interesting communications were read on the tremendous gale that visited this island on the 29th of November last. The most important were from the Rev. W. B. Clarke, of Poole, Captain W. H. Smyth, R. N., of the Observatory, Bedford, the Rev. W. T. Bree, of Allersley Rectory, near Coventry, Mr. W. H. Campbell, Secretary to the Botanical Society of Edinburgh, and Mr. S. G. Tatem, of High Wycombe.

From the manner in which the wind was observed to change its direction at various places during the gale, it was considered to belong to that class of hurricanes which traverse the western Atlantic. These hurricanes consist of a large body of air moving with considerable velocity round an axis which advances in such a direction as to describe an elliptic or parabolic curve, the apex of the curve being situated about the parallel of the thirtieth degree of north latitude. It was requested, that on future occasions observers would be careful to note particularly the phases of the storms, and the time when any change in the direction of the wind takes place.—*Loudon's Magazine of Nat. Hist., January,* 1837.

12. *Galvanism.*—Dr. Charles G. Page, of Salem, Mass., has lately made the valuable discovery that iron, lead, or any metal, may be substituted for the expensive article of copper in galvanic batteries, whereby the cost of this apparatus will be diminished by about one half. In order that a battery of this construction should equal one of copper and zinc, it is necessary that the exciting liquid should be some acid, holding the oxide of copper in solution, such as the nitrate or sulphate of copper. A solution of blue vitriol or the sulphate of copper, is preferable from its cheapness. A small plate of lead and zinc, each the size of a cent, immersed in a wine glass of the above solution, will give bright sparks, strong shocks, and produce decompositions when connected with a spiral coil of copper ribbon three hundred and twenty feet long, which is, for convenience, now generally called a dynamic multiplier. The superior action of such batteries appears to be owing to the greater readiness with which copper deposits upon another metal than itself. He has further found

that a tolerable good battery may be made of one metal only, viz. zinc, provided one of the plates much exceeds the other in size, and the sulphate of copper be used as the exciting liquid. To construct a battery of this description, a number of narrow strips of sheet zinc, arranged in the form of a cylinder, are immersed in a cylinder of zinc containing a solution of the sulphate or nitrate of copper; the zinc strips answering merely for conductors.

Among other discoveries lately made by Dr. Page in relation to this subject, we notice the production of sparks and shocks from a thermo-electric apparatus, consisting of a pair of bismuth and antimony plates heated by a spirit lamp. This condition has hitherto been wanting to establish fully the identity of thermo-electric, with common galvanic currents.—*Salem Observer.*

13. *Animal Electricity;* by MM. Linari and Matteucci.—The five helices employed by M. Linari, contained five hundred and seventy seven metres of copper wire. Two had the ordinary form; the three remaining were composed of the wire wound round spirally in a plane, and had a square perimeter. Through one of these helices was passed a cylinder of iron, 0^m 635 long, and 0^m 31 in diameter. This system of helices was connected and terminated by two plates of silver, provided each with an isolating handle. The circuit was interrupted by cutting the wire between the last helix and one of the plates of silver, in order to insert the extremities of the wire into a vessel of mercury and thus amalgamate them.

The experiment was performed as follows: the torpedo wiped dry, was placed on a plate of glass, with one of the pieces of silver upon his back and the other on his belly. The animal was then irritated by striking him with one of the plates on his tail and gills, and was thus induced to discharge himself. After several trials, M. Linari succeeded in obtaining a spark, which appeared between the mercury and the wire. By touching together the amalgamated wires out of the mercury, he succeeded in obtaining a succession of brilliant sparks. He observed no difference in the capabilities of torpedoes of different sizes to produce this result. A small one of four inches in diameter afforded a long succession of bright sparks.

The decomposition of acidulated water, and a durable magnetization of a steel needle were invariably obtained by M. Linari.

M. Matteucci employed in his experiments similar apparatus to that of Linari, containing however only three hundred metres of wire, of which he made two double helices. One of these helices was 0^m 44 in length, and had a diameter of 0^m 05*m*; the other was 0^m 72 metres in length, and 0^m 03 in diameter, and was wound on a horse shoe. In the interior of the two helices was placed a cylindrical bar of soft iron. With this arrangement, completed as above described, Matteucci succeeded without fail in obtaining a bright spark. One of the helices wound on a horse shoe sufficed to produce the same successful result.

Matteucci attempted to obtain the electric spark by means of two plates of brass, with short wires attached and inserted into mercury. But, notwithstanding the employment of every means which could insure success, he failed in obtaining any effect except the shock. He therefore infers, since the spark is not obtained with a very short wire, and on the contrary is easily obtained with the above described helices, that the spark is produced where the discharge ceases, in which case the current, *by induction*, adds to the primitive current.

He has also ascertained, by means of a delicate galvanometer, that the current passes from the back to the venter, and that the back may be considered the positive pole and the venter the negative. The discharge is effected in the same manner by the two organs situated on the sides of the torpedo, and the current is produced in the same directions when one of the needles of the galvanometer touches the ventral part of the left organ and back part of the right, or inversely. The deviation in the galvanometer is augmented if the two needles of platinum are put in contact with two metallic plates placed on the two sides of the fish, instead of a direct application of the needles. A discharge can almost invariably be produced by forcibly curving the torpedo, making the venter the interior of the curve. A removal of the skin of the animal diminishes the deviation, but does not entirely prevent it. If the outer of the three nervous cords which proceed from the brain to the electric organs are cut, the electric discharge may still continue. It ceases immediately on cutting the intermediate one.

These experiments were tried with thirty six individuals, which M. Matteucci obtained during a long residence at Cesenatico.—*L'Institut, No.* 167. *July*, 1836.

14. *Fall of Fishes from the Atmosphere in India;* by M. Prinsep.—The fact that fishes fall from the atmosphere in the rainy season, however incredible it may appear, has been so frequently attested

by credible witnesses that it can scarcely be doubted. As for myself, my credulity is compelled to yield to the discovery I made one day of a small fish, in my pluviometer, which was situated on an isolated pile of stones about five feet high, in my garden at Benares. A note from M. Cameron informs me that a rain of fishes occurred on the 19th of February, 1830, near Feridpoor. This fact was asserted before a magistrate, by many ocular witnesses, and it was their concurring testimony that towards noon of the above mentioned day, the sky was obscured, the rain commenced to fall, and shortly after, fishes of various sizes fell from the atmosphere. A large number were collected by several witnesses; some were found destitute of a head, and had commenced to putrefy; others were entire and fresh, but no one dared to eat them.—*Bib. Universelle, No.* 3, *Mars,* 1836.

15. *Nature of different Cements.* (Berzelius's Jahresbericht, etc. xivth year, 1st number.)

Fuchs has studied the nature of different species of mortars, and demonstrated that their solidification depends on the formation of silicate of lime, and sometimes also of silicate of alumine. These silicates retain some water and assume the firmness of stone, whilst the hydrate of lime in excess unites by degrees with carbonic acid; and consequently solidified mortar may be considered a compound of carbonate of lime and of a zeolite. *Opal, pumice stone, obsidian* and *pitch stone* pulverized, form with hydrate of lime a good cement. But only the surface of each grain of *quartz* or *sand*, is transformed into a hydrated silicate, and though this is sufficient to unite the mass, solidification does not take place so promptly. The mass becomes the more solid, the more finely the quartz is pulverized. If the pulverized quartz be mingled with one fourth part of lime, and after thoroughly calcining the mixture, it be pulverized and mixed with one fifth part of lime, it forms a hydraulic cement which becomes so hard as to be susceptible of a polish. Feldspar hardens slowly, and with lime only after five months; but if calcined with a little lime it is much improved. Common potter's clay, which is absolutely worthless in its natural state, affords with lime, when calcined, provided it contains but little iron, a cement which readily hardens.

Fuchs having discovered that *steatite*, which had been subjected to a red heat, could not be made to unite with lime, and thence concluding that magnesia has a strong affinity for silicic acid, attempted to employ calcined dolomite, in the place of ordinary lime, and found that it surpassed it, both as a material for ordinary mortar, and also for a hydraulic cement. He obtained a good mortar with this last material and calcined marl.

16. *Telegraphs.*—The House of Representatives of the United States, at their late session, Feb. 3, 1837, passed a resolve,

"That the Secretary of the Treasury be requested to report to the House of Representatives, at its next session, upon the propriety of establishing a system of telegraphs for the United States."

In compliance with this resolution, the Secretary, the Hon. Levi Woodbury, has issued a circular, with the view of obtaining information in regard to "the propriety of establishing a system of telegraphs for the United States," and invites the collectors, commanders of revenue cutters, and others, to furnish the Department of State with their opinions upon the subject, especially by pointing out the manner, and the various particulars, in which the system may be rendered most useful to the Government of the United States, and the public generally. It would be desirable, to present a detailed statement as to the proper points for the location, and distance of the stations from each other, with general rules for the regulation of the system, together with an opinion as to the propriety of connecting it with any existing department of the Government, and some definite idea of the rapidity with which intelligence could, ordinarily, and, also, in urgent cases, be communicated between distant places. An estimate of the probable expense of establishing and supporting telegraphs, upon the most approved system, for any given distance, during any specified period, is also desired. Information and opinions are also asked as to the practicability of uniting with a system of telegraphs for communication in clear weather and in the day time, another for communication in fogs, by cannon or otherwise, and in the night, by the same mode, or by rockets and fires, and returns are asked by the first of October, 1837.

As the subject is one of high importance to national and individual welfare, especially in a country of such vast extent and diversity of interests and physical features as the United States, we trust that the call of the House of Representatives and of the Hon. Secretary will meet with prompt attention and full replies.

17. *Scientific Congress at Metz.*—A circular printed letter which we have received, signed by M. Victor Simon, Secretaire de L'Academie royale de Metz, &c. &c. &c., announces that a scientific meeting of savans of France, Germany, and other countries, will be held at Metz in September. It is desired that the purpose of attending may be made known, and also the subject which the individual will discuss. This is the fifth meeting of the French scientific men, held in different cities in the departments.

Metz is about sixty five miles northeast of Paris; it is an ancient and famous city. It has eminent individuals, and various institutions for science and arts—for literature, humanity and arms. It has fine Roman antiquities, and is in the midst of a beautiful country. We trust that some of our countrymen will attend, as they have done in England as well as on the continent.

18. *New York Statistical Society.*—A statistical society has been recently incorporated by the Legislature of the state for the city of New York. Its capital stock is fifty thousand dollars, in shares of two hundred and fifty dollars each; the society to commence operations when the whole sum shall have been subscribed and five thousand dollars paid in. It may hold real estate convenient for the transaction of its business, provided the income does not exceed five thousand dollars.

The society is modelled upon the plan of that of London, incorporated in 1834.

All opinions are excluded—facts only being its object, and as far as possible, those that can be arranged in a numerical and tabular form. The subject was divided by the British Association at Cambridge, into 1. Economical—2. Political—3. Medical—and 4. Moral and Intellectual Statistics. The class of

Economical Statistics comprehends, 1st, the statistics of the natural productions and the agriculture of nations; 2dly, of manufactures; 3dly, of commerce and currency; 4thly, of the distribution of wealth, or all facts relating to rent, wages, profits, etc.

Political Statistics furnish three subdivisions, 1st, the facts relating to the elements of political institutions, the number of electors, jurors, etc.; 2dly, legal statistics; 3dly, the statistics of finance and of national expenditure, and of civil and military establishments.

Medical Statistics, strictly so called, will require at least two subdivisions, and the great subject of population, although it might be classed elsewhere, yet touches medical statistics on so many points, that it would be placed most conveniently, perhaps, in this division, and would constitute a third subdivision.

Moral and Intellectual Statistics comprehend, 1st, the statistics of literature; 2dly, of education; 3dly, of religious instruction and ecclesiastical institutions; 4thly, of crime. Although fourteen subdivisions have now been enumerated, it is probable more will be required.

It will, of course, be one prominent object of the society to form a statistical library, as rapidly as its funds will admit.

The gentlemen incorporated by the New York act, are James Tallmadge, James M. Matthews, Edwin Williams, Talman J. Waters, William Minot Mitchell, Samuel Cowdrey, and their associates, and the board of trust, for the present season, is composed of the same gentlemen, with the addition of Livingston Livingston, George Bacon, Benjamin D. Silliman, John W. Francis, Timothy Dewey, Reuben Ellis, and Jonathan Amory, with power to perpetuate the succession.

The subject of statistical societies for the United States, was recommended in this Journal, Vol. xxxi. p. 186, by Mr. Sanderson, as the representative of the Statistical Society of Paris, with which we have interchanged publications and correspondence ever since its institution. Although from the pressure of other duties we have been obliged to decline taking an active part in this subject, we are much gratified to find that it has been brought forward under the best auspices. The subject is one of extreme importance to the United States, in every view that can be taken of it—political, social, moral, economical, commercial: accurate facts, digested and arranged, so that the proper deductions shall of course flow from them, are no where so much needed as in the United States, because we are still in the forming stage of society—because our interests are immensely diversified, and because in this republic, beyond any nation that exists, or that ever did exist—man, in high intelligence, is in a state of the greatest activity, with the most numerous and powerful excitements and with the feeblest restraints. Political economy must be founded wholly upon statistics, and there is no way to obtain correct results but by a patient collection of facts.

Our able statistical writers, Seybert and Pitkin, would have derived immense advantages from the labors of such a society, and we hope to see its operations and influence become co-extensive with the nation. It is obvious that the subject admits, on this occasion, of cogent and ample illustration, from which we are precluded by the want of time and space.

19. *Officers of the New York Lyceum of Natural History, elected February* 27, 1837.

Joseph Delafield, *President.*
John Torrey, 1*st Vice President.*
William Cooper, 2*d Vice President.*
Samuel Thos. Carey, *Corresponding Secretary.*
J. H. Redfield, *Recording Secretary.*
John C. Jay, *Treasurer.*
Robert H. Browne, *Librarian.*

Joseph Delafield, Abraham Halsey, James E. DeKay, John C. Jay, E. L. Beadle, *Curators.*

John Augustine Smith, Jeremiah Van Renssalaer, Wm. Cooper, John Torrey, M. C. Perry, *Committee of Nomination.*

Wm. Cooper, Joseph Delafield, John Torrey, James E. DeKay, John C. Jay, *Committee of Publication.*

H. W. Field, A. R. Thompson, Archibald Russell, *Finance Committee.*

James E. DeKay, Orville Brooks, E. L. Beadle, *Library Committee.*

John Augustine Smith, *Anniversary Orator.*

J. H. Hill, *Draughtsman.*

20. *Transactions of the Maryland Academy of Science and Literature,* 1836. *June* 2.—Donations for the Cabinet were received from Dr. Keener, Mr. Alexander, Dr. Baxley, Dr. Geddings and Dr. Coale, and from Prof. Ducatel and Matthew Carey, Esq. of Philadelphia, several works for the Library.—Twelve volumes of the transactions of the Royal Society of Lisbon, were also received as a donation from that Institution.—Prof. Ducatel deposited in the library six livraisons of Goldfuss' Petrifactions.—Dr. Edmondson reported a table of Meteorological Observations for May, 1836, which was referred to the section of Physics.—The committee on Meteorological Observations made a report recommending the appointment of a committee of four, to have charge of the selection and construction of instruments—to prescribe the method of conducting the observations—and to invite the co-operation of other

members, in the labor of observations.—Lewis Brantz, James Green, J. H. Alexander, and Wm. R. Fisher, were appointed the committee.—Prof. Jameson, of Quito, Dr. Lewis R. Gibbes, of Charleston, and Rev. Virgil H. Barber, of Pennsylvania, were elected corresponding members; Commandeur Figaniere, chargé d'affaires from Portugal, was elected an honorary member.—The librarian was directed to have Greenough's Geological Map of England, deposited by Prof. Ducatel, mounted and varnished.

July 7.—A donation of valuable minerals was received from C. Tiernan, Esq.—Several works were also presented to the library by Dr. Riddell, of Cincinnati, and Drs. Wright and Hall, of Troy.—The committee on Meteorological Observations reported having procured the necessary instruments, and made the observation proposed on the 21st and 22d ultimo.

August 4.—Donations for the cabinet were received from Dr. A. Maddox, of Maryland, Mr. C. De Selding, J. S. Skinner, Esq., Mr. N. Potter, Mr. G. W. Andrews, and Dr. Coale.—Mr. Alexander presented a copy of a treatise on the principal mathematical instruments employed in surveying, by F. W. Sims; American edition with additions by J. H. Alexander.—The committee on Meteorological Observations made a final report, which was directed to be printed and circulated.

September 1.—Donations for the cabinet were received from Dr. Geddings, J. S. Skinner, Esq., Dr. Cohen, Mr. Minifie, Mr. Green, Mr. Fisher, and Dr. Coale.—Donations for the library were received from Dr. Riddell, of Cincinnati, Mr. Carey, Esq., of Philadelphia, and Wm. Maclure, Esq.—Dr. Edmondson reported a table of Meteorological Observations for July, 1836, which was referred.—M. Carey, Esq., of Philadelphia, was elected a corresponding member.—The meteorological committee was directed to continue their duties on the 21st and 22d inst.

October 6.—Dr. Maddox, Dr. Geddings, Dr. Palmer, U. S. Navy, and Mr. Minifie, presented specimens for the cabinet.—A treatise on the method of using chloride of soda, translated from the French of A. G. Labarraque, by Dr. Jacob Porter, was presented by the author.—James C. Palmer, M. D., U. S. Navy, and Dr. L. D. Gale, of New York, were elected corresponding members.—The committee on Meteorological Observations reported that the series of hourly observations had been made on the 21st and 22d of September, and that the table was being prepared for publication.

October 13.—The cabinet received donations from Mr. Minifie and Dr. Coale.—Charles Cramer, Esq. of New York, presented a catalogue of plants growing in the vicinity of Troy; and the Report of the Geological Society of Brussels.—Dr. Edmondson reported a table of Meteorological Observations for August, 1836.—Dr. J. W. Greetham reported a table of observations made at Mt. Vernon, Illinois, for June and July, 1836, both of which were referred to the section of Physics.—The chairman of the section of Botany reported progress in the arrangement of plants referred to that section.—Dr. Aikin was appointed to lecture at the sitting of the 27th inst.

October 20.—Dr. Coale presented the skeleton of a wren.—The section of Physics reported upon the tables referred at the last sitting, embracing in the report, suggestions of some modifications, which were approved by the Academy.—The section of Mineralogy reported the receipt of a suite of geological specimens from Heidelburg, and that they had been placed in the cabinet.

October 27.—Donations for the cabinet, from Mr. Quinby, Dr. Coale, Dr. Zollickhoffer, and the Maryland Colonization Society.—The remainder of the session was occupied by an interesting lecture from Mr. Quinby, on the mineralogy of the ancients, which was listened to with much attention, and a copy requested from the author for preservation in the library.

November 3.—Dr. Coale presented for the cabinet the skin of a monkey, tanned by the natives of Cape Palmas.—Donations for the library from Prof. Ducatel, Dr. Dunbar, Prof. W. R. Johnson, of Philadelphia, and Com. Figaniere.—Dr. Aikin delivered a lecture on the anatomy of plants.—Dr. Henry P. Sartwell, of Penn Yan, N. Y., was elected a corresponding member.—Mr. Fisher informed the Academy that the arseniate of baryta, recommended by him at a former meeting, he had since ascertained should be employed only when the use of powdered arsenic was impossible—hence its use should be confined to the preservation of the plumage of birds.—Mr. Fisher was appointed to read a paper at the following sitting, and Prof. Ducatel at the succeeding one.

November 10.—Dr. Coale presented the prepared skeleton of a "Corvus crestata."—Mr. Fisher read a paper on the present state of Pharmacy in the United States.—J. J. Audubon was elected an honorary member of the Academy.

November 17.—Donations for the cabinet were received from Mr. J. H. Naff, Dr. Riley, and Dr. Coale.—Prof. Ducatel read the introduction to an essay on the submersion of the Atlantis, being an attempt to show the reality of this event, and its probable connection with some geological phenomena.—Prof. Geddings gave a brief account of the insect which has proved so destructive to the elm tree. He described it as belonging to the genus *Crioceros*, species *vittata;* and concluded with a description of the mode in which the eggs are deposited, and the insect subsequently developed.

November 24.—Donations were received of several skulls and casts of skulls from Dr. Coale, and a specimen of the new British coin from Miss Minifie.—A circular letter was received from the Albany Institute, requesting the Academy to undertake a series of magnetic experiments, and acknowledging the receipt of the table of Meteorological Observations for June. The subject was referred to the meteorological committee.

NOTICES OF NEW BOOKS.

21. *Proposed New Work on American Skulls;* by Dr. Samuel George Morton.—Dr. Morton has, for several years, employed his leisure in collecting materials for a work, to be entitled "*Crania Americana;* or, *a Comparative View of the Skulls of various Aboriginal Nations of North and South America.*"

It is presumed that such a work, independently of its great *Anatomical* interest, will contribute something towards the *History* of the nations of these continents. The work will be in large folio, with twenty five or thirty plates, and two heads on a plate. It is designed to have at least fifty skulls lithographed of the natural size, with such national, individual, and anatomical illustrations, as can be obtained in reference to each. The work will be preceded by an Introduction, embracing a general view of the five great *Races* of Men, and followed by an exposition of the probable origin of the American Tribes.

Of one hundred and forty skulls of all the races now in Dr. Morton's possession, but sixty three belong to American tribes, and but twenty three of these are North Americans. Valuable as this collection is, and by far the most extensive of its kind in this country, it is yet very inadequate to the purposes above mentioned; and Dr. M. therefore respectfully solicits assistance in extending and completing it. The skull of any native tribe, if sufficiently perfect to figure, will be highly prized; and, where practicable, several individuals of the same tribe will serve an important purpose for comparison. The latter object will also be more or less subserved by the skulls of any of the races, more especially those of the Mongolian and Malay, as approaching nearest to the American.

22. *New Theoretical and Practical Treatise on Navigation, by M. F. Maury, Passed Midshipman, U. S. N.* 8vo. pp. 216, and 174 of tables, 9 plates. Key & Biddle, Philadelphia, 1836.—The author of this Treatise, is already favorably known to the public for his contributions to science, and the work before us amply sustains his character as an officer well grounded in the varied learning demanded in his profession. The work is appropriately introduced with chapters on Algebra, Geometry, Logarithms, Plane and Spherical Trigonometry, which contain whatever knowledge of these topics is deemed essential to a thorough understanding of the theory of navigation. The section on Nautical Astronomy and Practical Navigation, which next follows, unfolds these subjects in a logical and comprehensive manner; and also imparts much important instruction on the variation of the Compass, the Tides, and on the mode of conducting triangulating surveys. Appended to the work, are tables of Logarithms of Numbers; of Sines, Tangents, &c.; Proportional Logarithms; Latitude and Departure; Meridional Parts; Amplitudes; Atmospherical Refractions, &c. The style of the treatise deserves much praise; it unites fullness of statement with brevity and precision. The estimation in which the work is held among those best qualified to appreciate its worth, may be inferred from the fact that a copy has been ordered to be placed on board all our national vessels. It cannot fail to be of important service to the interests of nautical science.

23. *Gummere's Astronomy.*—An Elementary Treatise on Astronomy—in two parts—the first containing the Theory, the second Practical Problems—with an Appendix comprising Solar, Lunar, and other Astronomical Tables. By John Gummere, A. M. Second edition, enlarged and improved. Philadelphia, 1837.

We are glad to see Gummere's Astronomy presented to the public in a new and improved form. It is a valuable work, evincing a good acquaintance with the subject of which it treats, and comprising, (what can hardly be said of any other American work on the elements of Astronomy,) facilities for actually making astronomical calculations. The Solar and Lunar tables are abridged from those of Delambre and Buckhardt, and are of course of the highest authority. The astronomical student, however, may be informed, that the originals are not expensive, and, when practicable, they ought to be in his possession in preference to any abridgment. Still the tables, as given in this work, will be found adequate to the purposes of the beginner, and will indeed conduct him to a more accurate result than he can attain by the aid of most works of this kind.

The analytical methods of calculating eclipses, which the author has given, are refined and ingenious. For a school book, which will, we hope, be used in many institutions where Analytical Trigonometry has been little cultivated, it might, indeed, be desirable to exhibit a few examples of the plainer and more ordinary methods of making such calculations. We trust, nevertheless, that the rapid progress which mathematical science is making in our country, will shortly render such a provision unnecessary. We will only add the hope, that this work, the fruit of much industry and ability, will receive the extensive patronage which it merits.

24. *Twelve Lectures on the connection between Science and Revealed Religion;* delivered in Rome, by *Nicholas Wiseman*, ***D. D.***, Principal of the English College, and Professor in the University of Rome. Andover, 1837.—We did not look to Rome for a book of this kind; much less did we expect so able a discussion of the relation of Geology to the Mosaic history. Had we time and space, it would be highly interesting and instructive to give a full analysis of the whole book; as it is, however, we must content ourselves with briefly noticing his geological disquisitions. These are contained in the fifth and sixth lectures, under the head of "THE NATURAL SCIENCES." Although he does not enter *minutely* into geological discussion, he shows at every step of his argument that he is familiar with the great facts in geology, and with the general course of geological reasoning, and that what he says comes from a mind well stored by extensive and various reading, and matured by reflection. He says, with all other true philosophers, that we need have no fear in following truth, however far her torch may lead us from our preconceived opinions; confident, that in the end, she will not be inconsistent with herself. While our author is catholic, in the largest and best

sense of that word—no protestant could be more jealous of the truth and authenticity of sacred writ. We trust our friends among the clergy will read this book; they will find in it an example of candor and courtesy worthy of all imitation, while it is remarkable for its condensed learning and its fine taste. His two lectures on the natural history of man, are profound, and profoundly interesting, as indeed is the whole book as far as we have examined, although we do not feel ourselves competent to judge of the philological portions. The eight lectures we have not mentioned, consist of two on the *Comparative Study of Languages*, two on *Early History*, one on *Archæology*, two on *Oriental Languages*, with a concluding lecture.

25. *Dr. Buckland's New Work.*—Dr. Buckland's admirable Bridgewater Treatise has been republished in Philadelphia, with all its illustrations. Our opinion of this work was given in Vol. xxxi. p. 419, and want of time and space alone have prevented us from saying more of it in the present number.

26. *Lyell's Geology, 5th edition.*—The 5th edition of this excellent work, with considerable additions, and many new cuts in wood, has recently appeared in England, and we understand that the English copies are imported in large numbers into this country by some of our principal booksellers.

An American edition by Is. Kay and brother, is also about to appear in Philadelphia, copied with all the illustrations from the fifth English edition. We understand that the four large English duodecimo volumes will be published in two octavos, to be ready for sale in the month of May. Our opinion of this work is expressed in Vol. xxix. p. 358, of this Journal.

27. *An Introduction to Botany, by John Lindley, F. R. S., &c. &c.* Second edition, with corrections and numerous additions. London, Longman & Co., 1835. 8vo. pp. 560.—The estimation which this excellent treatise so deservedly holds, is evinced by the early appearance of a second edition; the important additions to which, indicate the rapid progress of the science of Botany during the two years that have intervened between the first appearance of the work and the publication of the present edition. It is illustrated by numerous wood engravings, and six crowded and beautifully executed copper-plates.

28. *A Natural System of Botany, or a Systematic View of the organization, natural affinities, and geographical distribution of the whole vegetable kingdom, together with the uses of the most important species in medicine, the arts, and rural or domestic economy, by John Lindley, F. R. S., &c. &c.* Second edition, with numerous additions and corrections, and a complete list of genera, with their synonymes. London, Longman & Co., 1836. 8vo. pp. 526.—The students of Botany in this country are generally acquainted with the first edition of this work, through the American reprint, edited by Dr. Torrey, and published by the Messrs. Carvill, of New York. The edition now before us is so greatly improved by the addition of original matter, and especially by the arrangement of the orders upon entirely different principles, that it might almost be considered a new work. The preparation of a complete list of genera, properly arranged under their respective orders, sub-orders, &c. must have been a very laborious and difficult task. It was, however, greatly needed, as, until its appearance, there has been no general enumeration later than that in the *Ordines Plantarum* of Bartling, published in the year 1830.

A more extended notice of the work may be expected in the ensuing number of this Journal.

29. *Hints on the cultivation of the Mulberry, with some general observations on the Production of Silk, by Lewis Tinelli*, Dr. of Civil Law in the Univ. of Pavia. New York, 1837.—This little book of about 50 pages 8vo., is designed chiefly to show that the cultivation of the mulberry and the growth of silk are as well suited to the soil and climate of the United States as to European countries. He begins with a brief history of the seropedic art, and then shows the prevailing opinion to be false that the successful growth of the mulberry requires a warm climate. In proof of this, he adduces the fact that Switzerland, Germany, and even Sweden, produce silk in large quantities and of excellent quality; and Lombardy, where some of the best silk in market is grown, is frequently covered with snow for two months of the year. He gives the preference to the Morus Multicaulis for this country, since it is so easily propagated by cuttings and requires no very peculiar soil. Our interest in the book is increased from the fact that the author is one of those injured and unfortunate men whom the tyrannical power of Austria has driven as exiles to our free and happy country, after wasting their bodies by years of severe imprisonment in her gloomy dungeons.

30. *Chemical Tables, exhibiting the present state of our knowledge in regard to the chemical and physical properties of simple and compound bodies, by James F. W. Johnston, A. M., F. R. S. E., F. G. S., &c. &c.* Part I. Edinburgh, 1836.—Several months since we received a note from the author of these tables, accompanying a copy, and also a blank schedule for chemical information, which was published in our last number, (p. 414.) Nothing but want of space prevented our noticing them at that time. The tables are drawn up at the request of the British Association, and they present another proof of the services which that body is constantly rendering to science. Prefixed to these tables is an explanation of their object and use. Dr. Johnston states it as a prime object to show what we do not know, as well as what we do; and he justly remarks, that some will be surprised to find how ignorant we are in *many particulars* of the most familiar bodies. He uses the symbols of Berzelius and the German chemists. Part 1st commences with inorganic bodies, and the first section contains an exhibition of the most important chemical and physical properties of the non-metallic elementary substances, and of their mutual combinations. Such a work is calculated to be highly useful, and to enlist new laborers in the field of original research.

NEW JOURNALS.

31. *Magazine of Zoology and Botany;* conducted by *Sir Wm. Jardine*, Bart., *P. J. Selby*, Esq., and *Dr. Johnston.*—The first No. of a Journal bearing the foregoing title was published last June. Four numbers—those for June, August, October, and December, have come to hand. If we may, from these numbers, judge what its character is to be, it will take the lead in its own departments, as well for original research and accurate monographs, as for a succinct and interesting abstract of all that is new, both in facts and the issues of the press. The names of its conductors are too justly celebrated to gain additional lustre from any thing we can say of them. Its character, we learn from the prospectus, is to be more scientific than that of any of the pre-existing journals of Natural History, and thus far it is well sustained.

32. *Thomson's Records of Science.*—It is now nearly two years since the first number of this excellent Journal made its appearance,

and although we have never before mentioned it to our readers, they will remember that it has often enriched our pages, and we also hope that many of them have a more familiar acquaintance with it. While it has fully maintained its character as a scientific journal of the first class, its pages have not been too much engrossed by mathematics and mere technicalities. We are sorry to learn from its able conductor, that like some of its cotemporaries it has lived by the hardest, and thus far barely paid its expenses. May it live to see brighter days, as it richly deserves.

33. *The Annals of Electricity, Magnetism and Chemistry, and Guardian of Experimental Science;* conducted by *William Sturgeon.* London, October, 1836, Vol. I, No. 1. Published quarterly. Price 2*s.* 6*d.*—A new journal of the above title has been sent us by the Editor, since the publication of our last number. Its prospectus states that it is to be devoted entirely to recording *all* that is new and interesting, either theoretical or practical, that may appear on the branches to which it is confined. We hope that it may prove itself worthy of support, and receive the assistance of able men, so many of whom are now engaged in these most important branches of research. The number before us contains two papers from our distinguished countryman, Dr. Hare. Also an account of some experiments by Dr. Henry, of Princeton, (erroneously stated to be of *Yale College,*) as related to Mr. Sturgeon by Col. Peabody, of Salem, Mass.

OBITUARY.

It is with feelings of the deepest sorrow that we are called on to record the death of Dr. Turner, the distinguished author of "Elements of Chemistry." In the "*Athenæum,*" of February 18th, we find the following painfully interesting facts:

"He died on Sunday, 12th February, at his residence at Hampstead, aged 40. The immediate cause of his death was inflammation of the lungs, which commenced in an attack of influenza. He had been suffering for many years under chronic affection of the intestines, by which his strength was extremely reduced.

"Dr. Edward Turner was born in Jamaica, but was early removed, for his education, to England. He graduated as Doctor of Medicine in Edinburgh. Having determined to make Chemistry the principal object of his study, he went, even after taking his degree, to Göttingen, where he continued for two years, devoting his whole attention, under Professor Stromeyer, to that science and the kindred one of mineralogy. He returned to Edinburgh in 1824, and began to lecture on his favorite science. On the foundation of the University of London, in 1828, he was appointed Professor of Chemistry at that Institution, to the success of which, as a medical school especially, by his character, his abilities, his indefatigable exertions as a man of science and as a teacher, his prudence, and the amenity of his manners, he has contributed a very ample share. His class has been large and constantly flourishing; his lectures were remarkable for the simplicity and clearness with which the most apparently complicated principles and facts were expounded, insomuch that he was considered by his pupils a model of an effective teacher. He always maintained and was most successful in showing that a course of instruction in any one department of knowledge may be made a high mental exercise, and the means of invigorating generally the reasoning powers."

"Dr. Turner's first publication was a small treatise on the Atomic Theory. He was the author of several papers in scientific periodicals, and in the Transactions of the Royal Societies of Edinburgh and London, of both which societies he was a Fellow.

"If Dr. Turner had not been so much distinguished by his enlarged intelligence, his consummate ability as a teacher and his fame as a chemist, he would have been nevertheless remarkable for his high moral qualities. It was impossible to have passed the shortest time in his society, or even to have "looked in his face," without being struck by the extraordinary amenity and benevolence which were his characteristics. It is a fact well known to those intimately acquainted with him, that his temper never appeared ruffled, and the tranquilizing effect of his mere presence on the angry feelings of others has often been remarkable.

"Dr. Turner was a member of the established Church of England, and a strict observer of its ordinances; but he afforded an example that sincerity in attachment to its principles is perfectly consistent with the toleration, in spirit, as well as in demeanor, of adverse opinions. His particular religious sentiments were never obtruded, and the strength of his feelings on the subject was known only to his family and most intimate friends.

"In his last moments he was tranquil and "perfectly content to close his career." Exhibiting and expressing the firmness of his faith, and his full trust and confidence in the redeeming effects of the sufferings and merits of Christ, he had his domestics assembled around him to witness the serenity with which he was enabled to contemplate the certain approach of death. It is no exaggerated portraiture of Dr. Turner's character to say, in a few words, that he afforded an extraordinary instance of the combination of the best and highest qualities, most accurate perception, enlarged intelligence, active benevolence, unaffected piety, universal charity."

Persoon.—The learned botanist of the Cape of Good Hope, M. Persoon, is now no more; he died at Paris at a very advanced age, having lived there since he enjoyed a pension from his government, which was granted to him on giving up his Herbarium to the Museum at Leyden. His works on Cryptogamea are excellent; and his Enchiridium Botanicum is one of the most useful works of its kind which has yet been published.—*Athenæum, Feb.* 18, 1837.

Mr. *Richard Cunningham*, the able botanist, who was connected with an expedition in New South Wales, was cruelly murdered by a band of savages, into whose hands he was so unfortunate as to fall, somewhere near the end of April, 1835. Loudon's Gardener's Magazine, contains a thrilling and interesting letter from his afflicted brother, which we have not room to copy. From this letter, we learn that he by accident, became separated from his companions, and after wandering some days, fell in with the savages before mentioned, who gave him food and allowed him to encamp with them for the night; that their suspicions were aroused by Mr. C.'s rising repeatedly in the course of the night, and walking about the encampment; and fearing lest it was his intention to betray them into the hands of some of their enemies, in the neighborhood, they determined, after consultation, to kill him, which they did by rushing on him with their spears. He had just completed his forty second year.

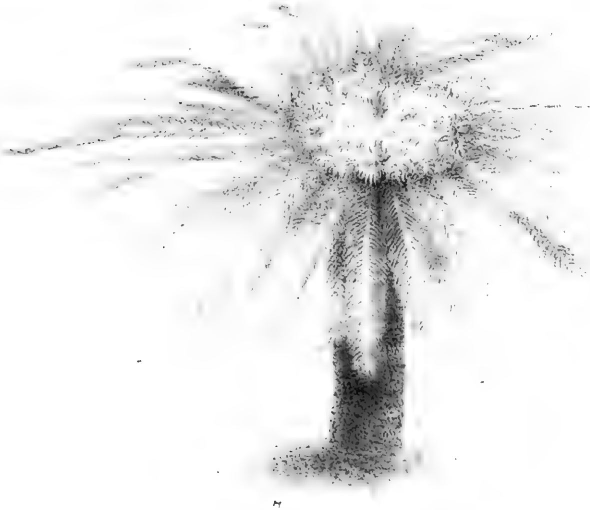
We announce with much regret the death of Mr. *Edward Turner Bennet*, Secretary to the Zoological Society, who died on Sunday, 21st August, after a short illness. By his decease the society has lost one of its most efficient office-bearers, and one whose province it was to detail the interesting additions which were acquired to the mammalia of the collection. In this department he ranked deservedly high; perhaps, so far as Britain is concerned, higher than any one. This will be borne out by the papers he has published in the the Transactions of the Zoological Society,—a work, of which he took the principal superintendence, and which for general execution, stands unrivalled. He is also known as the author of the Tower Menagerie, and the Gardens and Menagerie of the Zoological Society. His name will stand recorded by the Antelope Bennetii, Orthotomus Bennetii, &c. &c.—*Mag. of Zool. and Bot., Edinb.*

The painful news of the death of Dr. *William Henry*, the well known author of a celebrated work on Chemistry, and of many excellent memoirs, has been fully confirmed. In the expectation of a memoir prepared at the request of the Manchester Literary and Philosophical Society, by Dr. Wm. Charles Henry, son of the deceased, we postpone an obituary notice of this lamented philosopher, and excellent man, until ampler means of doing justice to his memory are placed in our hands.

East Indian Geology.

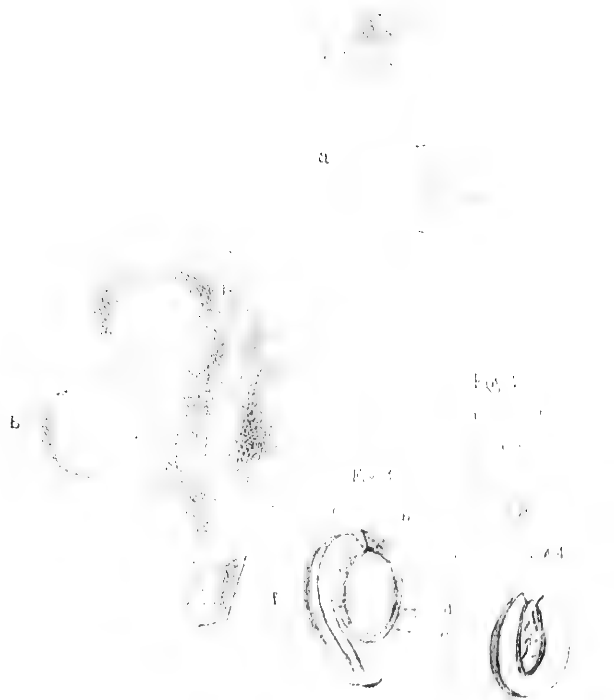
At the last moment, we have received from the author, Assistant Surgeon John McClelland, an original octavo volume, of 384 pages, with full illustrations, and printed in handsome style at Calcutta, Bengal, on the Geology, and other topics of Natural History of the Province of Kemaon, a portion of the region of the Himalayah Mountains. We hail this work with pleasure from this remote region, and shall notice it again on a future occasion.

PL I



PL II

Fig 1



THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Observations upon certain Auroral and Optical Phenomena;* by Alexander C. Twining.

The height of auroral phenomena is a subject which has divided philosophers. Some consider them as lying in the lower regions of the atmosphere; while others would elevate them beyond its supposed limits, or at least into its extreme upper regions. It is my intention to prove in three instances of late occurrence, that the latter opinion is the true one.

Auroral Cloud of December, 1835.

On the evening of the 10th of December, 1835, being at the village of New Britain, which is twenty six miles N. and 15° E. from the city of New Haven, I observed attentively, for more than an hour, an auroral cloud of very unusual appearance. At the beginning of my observations, about half past 8 o'clock, P. M. it was situated about 25° east of north, and at an average altitude of 11°. The star Beta Ursae Majoris was enveloped in its upper portion, but not obscured.

This altitude changed only 9° during the period of my observations, although the cloud moved horizontally towards the west not less than 20° in the same time. The cloud had a horizontal extent of at first about 16°; but was narrow (only 4°) in the vertical direction,—being irregular in its *upper* outline, but shaped, on the whole, somewhat like a very excentric semi-ellipse. Its lower limit however was a *well defined line;* and in respect of this feature the cloud continued unchanged, whenever it was visible, through all its expansions and variations. This lower limiting line was not exactly horizontal,—being elevated at first about 3° more at its *western* than at its *eastern* extremity. As the cloud moved round westward, this line assumed gradually a position more nearly horizontal. A remarkable circumstance was that the cloud would disappear at short intervals; after which it would gradually but rapidly light up again in the same place, and with the same shape nearly as before. This process of alternate vanishing and reappearing was continued at intervals of from half a minute to two or three minutes and more, during all my observations. The cloud had not only moved round to the west, but had increased, towards the last, in its horizontal extent to about 33°; but its vertical breadth was not materially changed, and the lower horizontal limit retained its well defined and rectilinear character. It disappeared rather suddenly at about a quarter before ten,—the altitude of its lower limit being then 19½°.

On arriving at New Haven, a day or two afterwards, I found that the same isolated appearance had been viewed attentively by several persons,—by Mr. Stanley, now Professor of Mathematics in Yale College,—by Mr. E. C. Herrick, and by an intelligent gentleman, a member of Yale College. From each of these gentlemen I obtained, previously to communicating my own observations to them, a careful description and delineation of this phenomenon—its changes and its location among the stars,—for the purpose of making three independent comparisons with my own particular minutes respecting the same. By a comparison of the aspects, the changes, the motions, and the time of disappearance, there could not remain a doubt that this cloud, seen at New Haven, was *identical* with the cloud seen by me at New Britain. In this comparison four circumstances conspired to favor a correct result.

First. There was no other auroral appearance seen in any part of the heavens. Therefore the different observers were viewing the *same thing;* which removes one of the usual and most perplexing uncertainties attendant on such comparisons.

Second. The two stations, twenty six miles apart, were nearly in a line with the cloud, and for a part of the time exactly so.

Third. The lower limit of the cloud, being a well defined line, and continuing so throughout, offered an unusually definite object for the estimation of altitudes, and for location by the stars.

Fourth. The motions being chiefly horizontal, and the changes of altitude very slow, an error of several minutes as to the time would not affect the comparison in respect of altitude, except in a trifling degree. Indeed, since the motion of the cloud was almost exactly *along its own rectilinear base*, and since the comparison of the observations at both stations was made by taking the distance of a fixed star (Alpha Draconis) from that base, it being distant only two or three degrees at farthest, it may be asserted that any uncertainty arising from a difference in the watches of the observers, or their estimates of the hour and moment, is completely done away by the circumstances of the phenomena.

Under these favorable circumstances, therefore, comparing the sketch and notes made *on the spot, and at the time of observation*, by Mr. E. C. Herrick, at New Haven, at 9*h.* 15*m.* P. M. with those made under like circumstances by myself at New Britain, and, as it happens, at the same moment, I find the distance from Alpha Draconis to be the same in both cases,—indicating the entire absence of a parallax sufficiently considerable to be detected by this kind of observation,—which is of course not expected to be exact,—within perhaps $\frac{1}{2}°$ or 1°.

Prof. Stanley had not minuted his observations, at the time of making them ; but before having access to any other observations he fixed carefully by recollection the situation of the phenomenon at 9*h.* 40*m.* P. M. The cloud thus delineated by him was almost *identical* in extent and situation with the same as delineated by myself, at the last specific observation made by me, at 9*h.* 30*m.* at New Britain,—except that the distance of the lower line from Alpha Draconis was in the first case 1° 40′, and in the last 3°—showing a parallax of 1° 20′ only.

The third observer before alluded to, having also delineated *independently* on a celestial map the same cloud as observed by him, gave it a situation, extent and form, agreeing closely with the observations of Prof. Stanley and Mr. Herrick. Not having the map at hand I cannot now state particulars, although at the time this observation afforded a striking confirmation of the truth of the general conclusions we are now about to deduce.

My object is *not*, let it be noticed, to show *the exact distance and height* of the cloud observed, but to exhibit proof of this one fact that it was *elevated, most unquestionably, either above the atmosphere, or into its extreme upper regions.* By Mr. Herrick's observations, compared with my own, made at, or certainly near, the same moment of time, it would appear that the cloud was too distant for a parallax sufficiently considerable to be appreciated. All however that we can safely deduce from this, (and so much is deduced with entire certainty,) is the fact that the parallax was very small.

Again, by combining Professor Stanley's observations with my own, made indeed ten minutes earlier, but still perfectly comparable with them in consequence of the peculiar and propitious circumstances before stated, it would appear that a parallax existed of $1\frac{1}{3}°$ between the stations twenty six miles apart. Considering therefore the definite character of the object, and the care taken in the different observations, and even allowing some latitude for errors attendant on the best observations of such bodies, there would seem to be no possible reason for suspecting in this case a parallax of more than 1° or 2°, or at most 3°. Indeed, by assuming the latter amount (3°) we shall be almost certain of assigning to the cloud a distance and height *far less* than the truth.

Assuming however a parallax so large as 3°, between the two stations, twenty six miles apart, and nearly in a line with the cloud,—the elevation at the most northern or nearest station being $19\frac{1}{2}°$, we find, without stating the calculation here, the distance of the cloud from New Haven in a direction a little east of north, to have been one hundred and forty one miles in a direct line; and the height above the surface of the earth to have been *forty two miles and one third.* This is the *nearest* point which we are at liberty to assign. It would have agreed better with our direct observations to have placed the cloud at a height three or four times as great: but in the present state of our knowledge it is most important to settle, if possible beyond dispute, the general question respecting the *region* in which the auroral phenomena have their residence. Therefore I have leaned to the extreme of caution.

Auroral Arch of August, 1836.

On the 12th of August, 1836, being on board one of the Hartford steamboats going to New York, I noticed, early in the evening, auroral lights of considerable brightness and beauty; but without making any particular observations. A little before ten o'clock, P. M. however, there appeared a streamer (as I took it to be) in the west, rising, not vertically, but somewhat obliquely—its higher parts inclining southward, and the whole of a yellowish hue. Just opposite to this, in the eastern quarter of the horizon, I soon noticed another streamer exactly similar and similarly inclined. At those portions of the streamers which were 20° above the horizon the obliquity to the *vertical* was about 17°. These streamers increased steadily in brightness, and their remarkable similarity and correspondence of position led me to look above, in expectation of finding them to be part of a connected line. Immediately over head I at once perceived an arch forming,—in appearance like a thin whitish vapor—well defined but narrow, and so faint that it would not have attracted notice, had not its existence been suspected and sought for. This circumstance seemed at first to suggest a probability that the bow might be arranged in a horizontal stratum of vapor, too faintly luminous, and too thin to make a strong impression on the eye looking *directly* through its substance, and requiring to be viewed through a section *oblique* to its length, and thus to have its successive parts accumulated upon each other, in order to give the impression of brightness. Soon, however, the parts over head increased in brightness, as did also those towards the horizon,—the part in the west being the brightest, and all having the apparent density of a common cirro-cumulous cloud. At 9*h*. 55*m*. I find by my minutes, made at the time, that the arch was *centered* over head in the star *Alpha Lyrae*, which appeared undiminished in brightness. At the same time its centre passed, in the east, through a star which I take to have been *Markab*, and in the west about $5\frac{1}{2}$° to the north of *Arcturus*. It was therefore at this time disposed *nearly* in a great circle, whose meridian passed 15° *east* of north, instead of about 6° west of north, as the magnetic direction of the region would have led us to expect.* At 10*h*. 5*m*. the arch was centered in Arcturus,—then about 20° high in the west. Higher up it cut the southern edge of Corona. Over head it had moved $5\frac{2}{3}$° southward in Lyra. In the east it had also advanced southward, but not more than 2° opposite the star before mentioned, then estimated to have 25° of altitude. It thus appeared evident that the western parts of the arch were in a state of more rapid apparent motion than the eastern, or even than the vertex,—since a motion of $5\frac{2}{3}$° over head would correspond (supposing the arch horizontal) to about 2° at an altitude of 20°,

---

* This refers to the *western limb* of the arch. The *eastern limb* would have its proximate great circle a few degrees nearer the east and west points. The arch was certainly not disposed in a great circle, as is evident from the fact that the extremities were much inclined to the vertical, while the arch passed through my zenith. It was much more probably disposed in a small circle.

whereas the observed motion was by estimation $5\frac{1}{2}°$, and possibly rather more. Either therefore the arch was nearer the earth's surface in its western parts, where it was also the brightest, or its visible extreme parts were in motion at unequal velocities. At this time the great circle that would nearly contain the western limb of the arch, would have its meridian about 12° east of north. In the position last given the arch was stationary for ten minutes. It was most brilliant at 10*h.* 15*m.* Two minutes afterwards it separated into parallel *fleeces*, distinct from each other, and lying oblique to the direction of the arch. These fleeces were in slow motion toward the west, keeping the line of the arch. The motion was such as made itself evident to the sight at the first instant of attentive observation. In other words it was sufficiently rapid to be just perceptible *directly* to the sense. At 10*h.* 30*m.* the arch faded almost entirely, so that I considered it as having vanished. Its position was then $11\frac{1}{3}°$ south of Alpha Lyrae,—south also of Arcturus and the Northern Crown, and south of its previous position in the east. On looking afterwards, I found that the arch had completely formed again in its last position, and was well defined, although faint. It disappeared altogether about 10*h.* 40*m.* P. M. without having changed place. The steamboat at 9*h.* 55*m.*, the time of my most definite observations, was nearly opposite Old Field Point, on Long Island. My position, as closely as I can estimate it, was twenty two miles S. 8° W. from New Haven.

Fortunately this phenomenon was viewed attentively at New Haven, by Prof. Olmsted, of Yale College, who obligingly put into my hand the loose paper containing his minutes, made on the spot, from which I extract so much as relates to the phenomenon during the time of my own observations already detailed.

"3*m.* before 10—arch—northern margin grazed Arcturus. Vertex on the Arrow, Dec. 18°,—covered the Dolphin. Vertex advanced no farther south, but western limb moved to the head of the Serpent, where it remained stationary till 25 minutes after 10, and disappeared."

"Western limb bent, being convex towards the south."

"Northern margin well defined."

"Parallel ridges N. E. and S. W. two to four degrees asunder, like parallel drifts of snow."

By attentively considering and comparing the two sets of observations given above, and made at points twenty two miles asunder, we derive the following conclusions.

First. The *identity* of the arch seen by Prof. Olmsted with that seen by myself is proved by several coincidences: by the coincidence in the first place, as to the time of its formation,—it being, according to Prof. Olmsted, at 9*h.* 57*m.* P. M., and according to my own minutes at 9*h.* 55*m.* P. M. Again, by the coincidence in the time of disappearance, which was put by Prof. Olmsted at 10*h.* 25*m.*, and by myself at 10*h.* 30*m.* Of course, the disappearance being gradual, there would naturally be some difference as to the exact moment, even if the watches of the different observers were just alike, which is not to be expected to a single minute, or perhaps more. My own time was carefully compared, on the following morning, with that of the clocks in New York, and all due allowances made to reduce it to time at New Haven. The faint reappearance of the arch after its first vanishing was not noticed by Prof. Olmsted. Further, there is a coincidence in the azimuthal position of the arches seen by both observers. In their first position, the meridian of both, it may be seen by a comparison upon the globe, cut the horizon at the same point—15 degrees *east* of north;* but in their final position this meridian, according to both observations, was shifted to a point several degrees nearer to the north,—yet all the while the entire arch was seen (as it ought to have been) in a more southerly position by the more northerly observer. Again, there was a coincidence in the remarkable phenomenon presented by the arch when it broke into parallel *fleeces*, as described by me, or *ridges* like parallel snow drifts, as described by Prof. Olmsted. Lastly, the arch being nearly over head to both observers, and the distance of the stations being only twenty two miles asunder, it is evident that if there had been two similar objects, and those even as low as the region of the ordinary clouds, both would have been visible to both observers. In fact however only one was seen by either. The combined force of these coincidences amounts to a *demonstration* of *identity.*

Secondly. The base line, although only twenty two miles long, was fortunately so situated as to subtend nearly the greatest possible angle and give nearly the greatest possible parallax. The arch was vertical within three degrees to its southern extremity, and the base itself varied in direction but a few degrees from the meridian of the

* This determination was made, as before mentioned, from the *western* limb of the arch, the eastern would show its meridian nearer the north point, but still east of it by several degrees—say 11°.

observed arches. That part of the arch therefore which was the *vertex* to on observer, would be almost *identical* with the part which was the vert to the other. Under these circumstances the upper parts of the a which were centered to Prof. Olmsted's view upon the *Arrow*, in N. Dec. 18°, were centered, to my own view, upon the star *Alpha Lyræ* in N. Dec. $38\frac{1}{3}$°—showing a *reduced* parallax of $19\frac{2}{3}$°, in the first position, and a height of *sixty miles* above the earth's surface. The parallax however appears to have been continually diminishing; for the vertex as seen by Prof. Olmsted was *stationary*, while the same, as seen by me, was constantly and progressively, although rather irregularly changing southward. This at first view perplexing circumstance involves no difficulty, except that it compels us to suppose that the arch had a *rapid upward motion*, which at the vertex was such as to coincide with Prof. Olmsted's line of vision; but which, being oblique to my own line of sight, would give an apparent southerly motion. This motion was so considerable as to reduce the final parallax to about $8\frac{3}{4}$°, and to increase the calculated final height to $144\frac{1}{2}$ miles. In computing the latter height, the southern observer's change of place by the motion of the boat has been estimated;—and the base accordingly assumed at 25 miles S. 23° W. from New Haven. The results of these calculations are to be taken only as near approximations, in consequence of the impossibility of fixing exactly my own situation on Long Island Sound. They are, however, doubtless, near the truth, and are *complete* for the object of demonstrating the great height of the *region* in which this auroral arch had its formation, and its changes. This arch was narrow,—not more than three degrees in apparent breadth; yet that breadth cannot have been less, in absolute distance, than an equal number of miles. It was visible at the extremities not quite down to the horizon; yet the part which was in view to either observer, cannot be estimated in the lowest position of the arch at less than seven hundred miles, and in its highest position it must have equalled eleven hundred.

Auroral Arch of May, 1836.

This appeared in the evening of May 8th. It has been mentioned by Prof. Olmsted in his memoir, published in the last No. of the Journal of Science. I had not myself the good fortune to witness it; but I have at my disposal the observations made at New Haven by Prof. Olmsted,—at Hartford, by Mr. P. W. Ellsworth, a late graduate of Yale College, and at Meriden by Mr. William Allen, an intelligent young man, and a member of my own engineer corps on the Hartford and New Haven Rail Road. I adduce these different observations, not to show the exact height of the object at any specific moment, (that height *may* indeed have been continually changing,) but in support of the main idea that it was elevated throughout far above the region of the ordinary clouds. With this purpose in view, I give in order the different observations, beginning with those of Prof. Olmsted.

By Prof. Olmsted the phenomenon was not seen until 9*h*. 55*m*. P. M. At that time the southern margin of the bow was seen resting upon the southern stars of the Northern Crown, while its northern margin lay along the tail of the Great Bear. It advanced southward until its south edge reached Arcturus, where it became stationary, and vanished at 10*h*. 10*m*.

Mr. Wm. Allen, being at Meriden, the half way point between New Haven and Hartford, saw the arch at its first formation. He was then riding slowly west, and witnessed the entire phenomena. Very soon after the formation of the bow the star Benetnasch, in the tail of the Great Bear, was in its southern margin; while Venus in the west was shining through it—and he thinks near its middle. The bow moved slowly south, and just before its disappearance separated into two parts,—one east and the other west of Arcturus, which then lay near the central line of the bow, while the star Mu Leonis was near its south edge. By the time he had ridden two miles the arch disappeared. This disappearance occurred a little after ten o'clock.

Mr. P. W. Ellsworth describes the arch as having begun to develope itself rapidly at half past nine, and soon afterwards passing from the east a little north of Corona, and extending as far as Castor; at 9*h*. 40*m*. the arch had advanced southward, passing through the Crown and south of Pollux, and at this period appeared most beautiful. In the east it terminated in an acute angle before reaching the horizon, resembling a column of white smoke. The arch had a milky appearance; it occasionally broke into waves, which advanced from the east with a rapid, regular motion, passing quite across to the west. These waves sometimes assumed a direction resembling the radii of a circle, but extended only a short distance from the arch itself. At 9*h*. 55*m*. the center of the luminous zone had reached Arcturus and the Sickle, and passing half across the Sickle suddenly disappeared at 10*h*. 5*m*. P. M. The light in the north assumed also the appearance of an arch, running nearly parallel with the other. It remained stationary, becoming now and then less distinct and again resuming its original brightness. A few faint beams of light radiated from the northwest towards the zenith; the sky was perfectly free from clouds, but was overspread with a thin veil of light rendering the smaller stars obscure. The weather was cool, with a wind due north.

In the comparison of the foregoing observations with each other, they manifest a consistency extending through every period of the bow's progress and duration. Thus, in the first stages of the bow, and very soon after its formation, Mr. Ellsworth, at Hartford, saw it lying north of the Crown and of Castor,—certainly at nearly the same moment when Mr. Allen, sixteen miles south of him in latitude, saw the same entirely north of Benetnasch, in the tail of the Great Bear. There would seem by this to have been a parallax of about half the breadth of the bow, or a little more—say 7°, to a base of sixteen miles. Again, in the middle stages of the bow, Prof. Olmsted, fifteen minutes before its disappearance, saw it passing through the Northern Crown, in a position certainly not varying widely from that assigned to it in the same constellation, by Mr. Ellsworth, twenty five minutes before the disappearance. The parallax, therefore, due to a base of thirty two miles would seem by this to be equal to the motion of the bow in ten minutes—say 12°. Finally, in the last stages of the bow, Prof. Olmsted saw it vanish when its south margin had just reached Arcturus, while Mr. Allen, sixteen miles north, saw its middle upon Arcturus "just before" the disappearance,—and while Mr. Ellsworth, still sixteen miles farther north, saw the same star in the same position relatively to the bow, "ten minutes"—before the disappearance. The parallax between the stations at New Haven and Hartford, would, by the last comparisons, appear to be something greater than the motion of the bow during the last ten minutes of its appearance, during a part of which ten minutes, according to Prof. Olmsted, it was stationary. The motion was about the same according to each observer—rather exceeding, in the average of all three, one degree to a minute. The breadth of the bow *in its middle stages*, appears by Prof. Olmsted's observations to have been about 12°. It is impossible, from the foregoing observations, to fix upon a definite parallax, although we may *approximate* to it with entire certainty. The observations are *perfect* in relation to the general object of the present paper—since the largest paral lax which could be assigned, consistently with the observations, would elevate the bow more than *one hundred miles* above the surface. Indeed, Prof. Olmsted has publicly expressed his own judgment as to the height of this bow at the time of his observations, which he makes as great as *one hundred and sixty miles.* The last, however, ought perhaps to be esteemed the *maximum* height which we are at liberty to assign. The meridian of this arch, like that of August, appears to have been directed to the east of north.

Dip of the Auroral Streamers.

In the brilliant aurora of Nov. 17th, 1835, a corona was formed at about 11 o'clock, P. M. Its position was, to my own view, in $23\frac{1}{2}°$ N. Dec. I made the observation at Berlin, in Lat. 41° 40′. Taking into view the position of the magnetic meridian, the dip, of course, was 71°, very nearly, at that place. The first corona of April 22d, 1836, at about midnight, was, to my view at New Haven, (lat. 41° 18′,) in $23\frac{1}{2}°$ N. Dec. It moved regularly north, and in three quarters of an hour, was in $25\frac{1}{3}°$ N. Dec. In one hour and a quarter more it had returned to 24° 10′. The average dip would be about $72\frac{1}{4}°$. Much the most definite observation of the kind I have been able to make was on the occasion of the magnificent display of Jan. 25th, 1837. The corona was then situated in Dec. N. $23\frac{3}{4}°$, and the dip was of course near $71\frac{1}{2}°$.

I take this opportunity to relate the occurrence of a few optical appearances, which I have witnessed at different times, and which may deserve notice.

Supernumerary Rainbows.

In the latter part of September, 1823, being on the river St. Lawrence, and having arrived at Montreal just at sunrise, I noticed in the west a dark blue cloud, which came over rapidly. The sun was shining very brightly from the opposite quarter, and formed in the cloud a bow of remarkable vividness and completeness. The secondary was also complete, and nearly as distinct in all its colors as the primary commonly is. The primary, although vivid, was less cheerful than usual in its aspect; owing probably to the sombre shading of the cloud seen through it. The violet seemed darkened to a dull red. Under the primary, an arc of the same color with the interior of the primary, (i. e. violet, or rather a dull red,) extended parallel with it nearly through the arch. Then followed a second arc, still beneath, fainter and of but half the extent. Below this a third was just discernible. The successive intervals between the interior of the primary and the colored arcs were equal,—each being less than the breadth of the bow. It appeared to me that all were distinct bows lapping upon one another,—the single color above mentioned of the supernumeraries was however alone seen, leaving apparently an unoccupied interval upon each side of it; probably because the intervening colors—being some compound of blue—could but feebly contrast with the cloud itself. The other colors mingling with the superior bows and chiefly with the violet could not be perceived; except in enhancing the *dulness* of that color, already mentioned.

I have at other times seen a *single* violet supernumerary arch, sometimes *exterior* and sometimes *interior* to the primary, but nothing in the least comparable to the foregoing. I had imagined also that I noticed the same phenomenon in the spray at Niagara Falls.

So many supernumerary bows as existed in the case mentioned by me as being visible at Montreal, form a combination of rare occurrence. The writer of the article "Optics," in the Library of Useful Knowledge, relates the occurrence of the phenomenon to his own view with *four* successive supernumeraries,—the *red* of each lower bow mingling with the violet of the bow next above.* The cause of the phenomenon appears yet to be unexplained.

While on the subject of rainbows, I must not neglect to notice a remarkable attendant upon one of great beauty, which appeared at seven o'clock, A. M. on or about Oct. 25, 1836. From the southern extremity of this bow, and tangent to it where it met the horizon, there arose a vertical column of the same apparent breadth with the bow, and having its colors, according to my recollection, in the same order. The appearance was faint, but too indisputable to be classed as an optical illusion. It did not rise so high as to cut the secondary; indeed, at its upper extremity, it evidently began to have a deviation to the right or towards the primary. This phenomenon was witnessed by many persons in different situations, and was a subject of general remark at the meeting of the Connecticut Academy in the evening of the day.

* Whether the supernumeraries seen by myself were *four* in number, or only *three*, would depend upon the question whether the colored arcs were to be esteemed violet or red,—a point respecting which I had expressed myself doubtfully in my minutes.

Halos in January, 1835.

Many years ago, on one excessively cold morning, there were seen, upon the plain of West Point, by persons looking towards the sun, upright columns of great splendor, and of prismatic hues, far exceeding in brilliancy any rainbow which had ever been witnessed by the individual who described this to me. Of this phenomenon I cannot give a more particular description; but it was, I presume, identical with the one which I am about to describe.

The morning of Jan. 5th, 1835, was excessively cold,—the thermometer having been before sunrise down to 16° below zero at West Point, where I then was. At a quarter before nine, A. M. I observed the air to be full of bright *spiculæ*, settling down upon objects like the hoar frost. Being instantly reminded of the foregoing spectacle, which had been formerly described to me, I went out of doors in search of something similar. The air was very calm and still—moving I should think a little from the north or northwest. Looking towards the sun, I saw at once on each side of him, for perhaps 30°, the arc of a halo, of which he was the center. The arcs might easily have been taken for upright columns. They were prismatic; the *violet* being *exterior*, and the *red* being *interior* or towards the sun. They were nearly vertical; the brightest parts being opposite the sun on each side, horizontally. I measured roughly the diameter of the halo, and found (taking the average of the colors) that it was just 45°. There was, in addition, a bright column, of the breadth of the sun, and not prismatic, which passed perpendicularly down from that luminary to the horizon,—or rather to the surface of the river, which was two hundred feet below me, and one quarter of a mile distant. This column was of the hue of sunlight, or twilight, but rather faint, as were also all the phenomena. There was at the time a smokiness in the air, like that of "Indian summer," which I took at first to be the effect of the floating spiculæ; but it continued visible just as plainly after they were gone. Indeed it continued all the day. At twenty five minutes past nine, I re-measured the halo with much care, although by rough means, and found its diameter as before, just 45°. This result was certainly very near the truth. Some time after this, its halo disappeared, although the spiculæ remained in the air. The column of light which passed up to the sun was not visible far, if at all, above it; but the luminous arches extended, I should say from recollection, as much above their brightest point as beneath.

Art. II.—*Geological and Mineralogical Notices;* by Oliver P. Hubbard, M. D. Professor of Chemistry, Mineralogy, and Geology, in Dartmouth College.

TO PROFESSOR SILLIMAN.

Dear Sir,—Enclosed are some observations, made two years since, during an excursion in the northern part of the State of New York, which are at your service, should you think them worthy of being recorded.

At Boonville, Oneida County, N. Y., the underlying rock of the country is the transition limestone, which has been heretofore described in its extent and outlines by Prof. Eaton, and I only wish to mention its appearance and character at this one point in the line of its direction from Trenton Falls to Lake Ontario. The surface, when the soil is removed, is found smooth, as if worn by attrition, but which may be owing to an equable disintegration produced by causes in constant action. Throughout the soil and on its surface are scattered large, thin, flat curvilinear masses of the same rock, which are also worn smooth. The rock is burned extensively for lime—is very hard, and being stratified in layers of moderate thickness, is easily quarried.

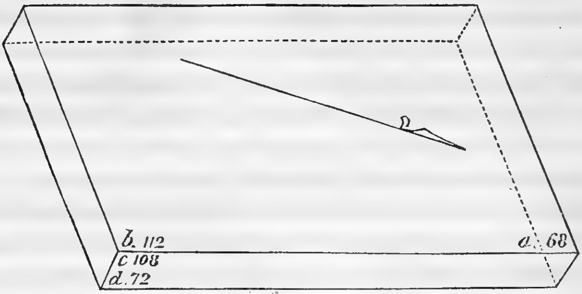
In the cliffs of the river banks, the layers are of variable thickness—when affected by the weather, they are quite thin, broken into small irregular blocks, and generally they are separated by a thin layer of argillaceous earth, like mortar in a wall. The upper beds appear entirely filled with petrifactions, crinoidea, terebratulæ, &c. interstratified occasionally with others, which contain no organic remains. These facts, with some other interesting features, may be conveniently observed on a stream in Leyden, Lewis Co., (about three miles from Boonville,) called "Dry Sugar River." About a mile and a half from its junction with the Black river, it is compressed into a narrow, irregular, rocky passage, and makes a cascade of sixty feet or more into an expanded basin below—and at high water runs with a full channel to its mouth. The banks from the basin are probably eighty or one hundred feet high, and continuously form the western limit of the great valley of the Black river, which here gradually slopes on the west side of Dry Sugar river to an elevation of thirty or forty feet, and on the eastern suddenly declines to nearly the level of the water. At the common height of the stream, (as at the time of my visit,) there is not water sufficient to cover the whole channel from the fall to its mouth, and at half way between the two, the stream is engulphed in some fissures in the rock, and at a distance of two hundred yards issues again at the base of a small ledge and finds its way in an open and shorter current to Black river. The channel below this fissure is therefore perfectly dry. The rock in the wood near by, is cavernous, as indicated by the subterraneous passage of the river—by several small accessible caverns, with roof and sides formed of large confusedly congregated masses, and by a rumbling noise when a carriage is driven over the road—the structure of this part indicating the effect of a powerful disruptive agency.

In the dry bed of the stream the rock has a different aspect in several particulars from the superior strata as found in the cliffs—the fossils are madreporites, corallines, and orthoceræ, in great number, and the latter of large size imbedded and their upper half abraded by the current, but their septa, as usual, harder than their gangue, still projecting above its surface. These are from two to three feet in length; the siphunculus filled with calc spar, and the whole in some cases mineralized, as it were, by a hard, black limestone, with a conchoidal fracture.

All attempts to detach a complete specimen were futile, but my search was rewarded by finding loose the smaller termination of an orthocera, perfect in its external form—septa oblique to its axis—about eight inches long—diameters at the upper end five inches and three inches and a half—and circumference twelve inches and a half; and if the entire length were in proportion to these dimensions, compared with the specimens above cited, this one must have been many feet long.

The strata here are much thicker than those in the upper series, and the bed of the stream in its whole width, and for a quarter of a mile, is divided at various distances apart, by several parallel longitudinal fissures, which are not vertical, but have a considerable dip to the east and a direction as nearly as I could judge without a needle, N. by W. and S. by E. Obliquely these are intersected by other similar fissures—direction nearly N. E. and S. W., and dip S. E. nearly. The intersection of these, of course divides the rock into rhomboidal blocks, having *a double inclination*, whose sides are oblique angled parallelograms, and each opposite pair equal and similar. With two straight edged sticks, the only means at hand, I attempted, with the assistance of a friend, to measure the angles of intersection of the fissures, which were transferred carefully to paper with the pencil, viz. *a*. $67\frac{1}{2}°$, *b*. $111\frac{1}{2}°=179°$; *c*. $107\frac{1}{2}°$, *d*. $72°=179\frac{1}{2}°$. Allowing for error in measurement of half a degree, we have the following result—to *a*. and *b*. and *c*. add half a degree, and we have *a.* 68°, *b.* 112°=180°; *c.* 108°, *d.* 72°=180°; from which was constructed the annexed figure. These measurements

Rhomboidal Limestone.



7 feet long, 5 wide, 1 thick.

were repeated on the same stone, and on different stones, and the angles opposite to them were also measured, and found to vary in no important manner, indicating a very remarkable regularity and parallelism of the opposite sides. Running across the stones in two directions, parallel to the sides, were distinct superficial cracks, and cleavage through them would cut the mass into many precisely similar solids; showing clearly, that the same cause that produced the main fissures, now by the running water, enlarged to inches in width, completely impressed its force and conferred a similar structure upon the whole. The dimensions of these rocks are very various, as may be seen by the measurement of some—ft. 1×1×6. 5×7×1—figured above, 4×6×24. This last, with the specific gravity of 2.5, must weigh 37½ tons.

The attention now paid to the structure of rocks by such observers as Conybeare, Sedgwick, De la Beche, and others, assures us of the importance of treasuring up every fact, and in its description descending to minute particulars, how little soever we may at present be able to appreciate them. I regret therefore that my time having been mostly devoted to the collection of minerals on that day, prevented definite observations on some collateral points of importance, as the dip, direction, &c. of the strata—though my impression is they varied little from a horizontal position.

This subject has excited new interest, and received new light from Mr. Hopkins' researches, reported to the late meeting of the British Association, and the facts constantly multiplying seem already to promise the induction of some important general law. The remark of Mr. Phillips that "the regularity of the structure (in the arenaceous, argillaceous, and calcareous rocks) increased with the antiquity of the rock," and "was well exemplified in the older slates and limestones," receives marked confirmation from this instance, as well as from the rhomboidal sandstone near Hartford, (Vol. XVII. p. 124.) Is there in these examples (the sandstone is without doubt calcareous) the result of an unknown or the modification of a known law analogous to crystallization? Is not the rhomboidal the more common of all *symmetrical* structures in stratified rocks? Facts, certainly, seem to lead to this conclusion.

Boulders.—An interesting and prominent feature in the geology of this region, and which cannot fail to attract the notice of every casual observer, is the numerous and immense boulders of primitive rocks, unlike any thing he would find here *in place*, which are scattered every where over the surface. They are principally of the granitic family—a red sienite prevails—masses of decidedly hornblende rocks—others composed entirely of white feldspar and glassy quartz—others still of grayish feldspar with brilliant cleavage-surfaces and crystals of mica and scales of plumbago.* One single boulder was discovered very much resembling the Labrador felspar—contained no quartz—but many small four sided prisms not unlike in external appearance to zircons. These are scattered upon the hills, accumulated in the valleys and the beds of streams, particularly of Black river, running north, and of Lansing's Kill, a branch of the Mohawk, running south. Boonville is the summit level of this region, being about six hundred feet higher than the level of the Erie Canal at Rome, and its waters part, descending north and south. The gravel hills cut through by the roads show the boulders buried throughout, twelve or fifteen feet from the surface. These and others found in the streams, as at the accumulations below High falls in Black river, bear the marks of long continued attrition, and are smoothed and rounded, while the larger ones on the surface, which from their size appear almost immovable, would seem from the freshness of their fracture and their salient angles, to have been simultaneously and by the same causes, separated from their original bed and transferred to their present position. The source of these rocks must be sought in the north and east, as none of their character exist probably south of this place in the whole state; this proves a northerly current, of which we have

* Since the above was written, I have received Prof. Emmons' Report on the geology of the northern part of New York. He finds in place rocks on a grand scale, of which the boulders here cited appear to be types, e. g. the red granite of the Kayederosseras range and at the Thousand Islands, containing beds of white felspar, and especially the "gray bluish green" felspathic rock that contains the Labrador felspar, and whose boulders are found in the valley of the Hudson in Orange Co., at Little Falls, and now at this place, and some thirty miles farther west and north.

such decisive evidences in the boulders of New England and the western states. In Brown's tract, (a wilderness region lying northeast, richly stocked with game and filled with delightful lakes,) I am informed by those who frequent it for hunting, that the eminences are composed of rugged, primitive rocks covered with a hardy growth of evergreens. It is probable, from the investigations on the northwest and east near Lake Champlain, where the primitive rocks are found, that it is but a short distance from Boonville to the junction of the transition limestone with the earlier formations. In fact, all that part of the state north of the Mohawk and Black rivers is described in Maclure's sketch and map as primitive, although further examinations may modify this view; and if I mistake not, the bed of the Black river near Boonville is partly in granite, and the High falls are made by a granite ledge, or dyke—although as my recollection of these observations is indistinct, I would not assert them with entire confidence.

New Locality of Calc Spar.—Information from a young farmer that "they found diamonds in his neighborhood," induced me to visit the spot he pointed out, expecting as usual to find fine crystals of quartz. It was on the western bank of the Dry Sugar river, and on clearing away a large quantity of earth and stones, several tortuous vertical cracks were discovered, six or eight feet long, in some parts of sufficient width to insert the hand, and filled with wet argillaceous earth, containing great numbers of loose imperfect crystals of calc spar. The face of the rock on each side of the vein was entirely covered with an incrustation of beautiful crystals. Their form is represented by figures 96 and 97, of Shepard's Mineralogy—the *equiaxe* of Haüy, with the lateral angles replaced by tangent planes variously produced—also figure 19, Pl. 3, in Cleaveland's Mineralogy. Some of the crystals are an inch in length—"six sided prisms with pentagonal sides, terminated at each extremity by three pentagonal faces, which stand on alternate lateral planes, and form with them an angle of 116° 34′." The rock is very hard and divided into layers of from two to twelve inches, and it requires much labor and care to extract the specimens without injury.

Green Coccolite.—Large boulders of green coccolite and glassy quartz, in about equal proportions, are found interspersed with those of granite in Boonville and Leyden, and when laid up in the farm walls, with the fresh fracture exposed to view, the pieces have a most beautiful appearance. I have found pebbles of this kind in the Mohawk at Rome, and at the foot of High falls on Black river—thirty five miles apart.

The coccolite, of a deep green color, occurs in masses of large granular concretions, and in grains disseminated through the quartz, presenting in its fracture, brilliant cleavage faces, partially developing the primary form. The coccolite encloses rhomboidal calc spar of various hues; and on blasting to obtain unweathered specimens, the rock opened through several veins of *Tabular Spar*, which remained on either face, coating it with a thin layer of most delicate whiteness. Crystals of prismatic *green pyroxene*, an inch in length, were observed in one instance.

In a large boulder, (near the road on the right, just before entering the village of Boonville from the south,) some thirty feet in circumference, and eight or ten feet in height, were several veins of white feldspar and quartz, from two to five inches wide, intersecting each other and extending through the rock, which contained in profusion the *brown granular garnet*, and a few points of the green coccolite. These minerals were noticed in Vol. XIII. p. 198, and richly deserve for their beauty the high encomiums there bestowed; and the fact last mentioned illustrates the uniformity which prevails in the associations of minerals, being the same as found at Willsboro' and other places.

Art. III.—*On the Economical Uses of some species of Testacea.*

(Concluded from No. I. page 73.)

VI. Murex ——? (Linn.)—Hebrew *Argaman*. Greek *Πορφυρα*, and Lat. *Purpura*. *Purple Whelk.*

What the species was from which the ancients obtained the real Tyrian dye, is now uncertain, but in coloring cloth there is no doubt that many species, and perhaps two or three genera, were used. The *Murices*, the *Buccina*, and the *Strombi*, and probably most of the voluted univalves, contain more or less of the coloring matter, and we may reasonably suppose that they would not be neglected where there was so great a demand for the purple dye. By the old writers, however, they are all described under one name. Pliny makes mention of two species, from one of which only the true color was obtained; the other (which he calls *Conchylium*) seems from his description to have been a real Buccinum, and produced only a poor blue or greenish hue, like the sea in a storm, while it emitted a strong rank smell, and was of course less valuable. The shell dye has been in use from the earliest periods. Moses, B. C. 1491, makes mention of it in several places, and he used much wool of a purple color in the works of the tabernacle, and in the garments of the High Priest.* This the Israelites must have brought out from Egypt with them, and from the quantity in their possession it cannot have been very scarce in that country. It was used as royal robes by the kings of Midian, B. C. 1249;† and B. C. 606, the Babylonians covered their idols with garments of purple.‡ At the same time it was also the royal color among these people, and we find that Daniel, after explaining the writing on the wall, as a special mark of favor, was clothed in it.§ Alexander Balus, king of Syria, sent Jonathan Maccabeus a crown of gold, and a purple robe, allowing him to take the title of king's friend.|| The band or Cydaris, which formed the essential part in the old Persian diadem, was composed of a twined substance of purple and white; and any body below the royal dignity presuming to wear these colors, unsanctioned by the king, was guilty of a transgression of the law deemed equal to high treason.¶

Although in after times it was almost exclusively known by the name of Tyrian purple, yet it appears to have been only on the decline of that great commercial city that it was manufactured there. It is mentioned by Ezekiel,** B. C. 588, as being imported from the Isles of Elisha, (Peloponnesus;) and Aristotle,†† as late as B. C. 340, makes no mention of its being brought from Phœnicia. In his time the best and largest shells were from Sigeum and Lectum on the promontory of Troas, and the smaller and inferior from Euripus and Caria. When, however, Tyre had lost its commerce, and become an inferior place, the chief supply of Europe was drawn from it, though we find it imported into Rome from Lacedemon, and manufactures of it in various parts of Italy as late as A. D. 14.‡‡ During the earlier periods of the Roman republic it was solely worn by the kings and patricians, but in later times Pliny§§ informs us that

---

* Exodus xxv. 14. xxviii. 5—6. Josephus, Act. Jud. lib. iii. c. vii. § 7.

† Judges viii. 26. ‡ Jeremiah x. 9. Baruch vi. 12. § Daniel v. 7.

|| Maccabees i. 20. These references are from Calmet's Dictionary, Art. PURPLE, where they are distinctly understood to refer to the dye from the shell.

¶ Sir Robert Ker Porter's Travels in Georgia, &c. Volume ii. p. 154, *quoted in* Horne's Introd. to the Holy Scriptures, Vol. i. ch. iii. sec. 3. § 3.

** Ezekiel xvii. 7. †† Aristot. de Hist. Animal, lib. v. cap. 15.

‡‡ Macpherson's Annals of Commerce, Vol. i. p. 124. Juvenal, Sat. viii. 101.

§§ Plin. Hist. Nat. lib. ix. cap. 36. lib. xxxi. cap. 10. from which all the information with respect to the Romans is drawn, where not otherwise pointed out.

cloth of this color was so common as to be employed as tapestry, and for the covering of furniture, by all the better class of citizens. He also remarks, that so great was its antiquity that the introduction of it was unknown to him, and adds from the chronicles then extant, that Romulus and his successors used it—which was perhaps only the same as saying that the first invention of it could not be traced. The Grecian tradition, but which of course was merely a fable, was that Hercules Tyrius was the first discover of it, his dog by chance having eaten the shell fish, and returned to him with its lips tinged with the purple color. Da Costa imagines that the dying qualities of the periwinkle (*Buccinum Lapillus*, Linn.) were known to the ancient British, and quotes the authority of the venerable Bede, who lived (on the sea coast) in the early part of the eighth century.* Among the Greeks, Lycurgus ordered the Lacedemonians to clothe their soldiers with scarlet, [*purple;*] the reason of which institution seems either to have been because this color is soonest imbibed by cloth, and most lasting and durable, or on the account of its brightness and splendor, which the lawgiver thought conducive to raise the men's spirits, or lastly, because it was most proper to conceal the stains of blood. In war, a purple garment was frequently placed on the end of a spear and used as a flag or signal.†

And though Jesus Christ was clothed in purple before his crucifixion, as a mark of derision, yet at this time it does not appear to have been either universally or necessarily worn by princes. Herod, when giving audience to the ambassadors from Tyre and Sidon, is described as being dressed in "*royal apparel*," which was not purple, but, as Josephus tells us, was wholly of silver.‡

---

* "*Sunt cochleæ, satis superabundantes, quibus tinctura coccinei coloris conficitur; cujus rubor pulcherrimus nullo unquam solis ardore, nulla valet pluviarum injuria pallescere, sed quo vetustior, eo solet esse venustior.*" Bede, Hist. Eccles. lib. i. cap. i. See Donovan's British Shells, in loco *B. Lapillus*. It is to be remarked that Bede lived at Jarrow, about five miles from the mouth of the river Tyne, which there divides the counties of Durham and Northumberland, and the rocks on that coast at the present day abound with this shell: indeed, so plentiful are they, that it may almost be said that acres of rocks are hidden from sight by the clustering of the fish, intermixed with the *Balanas elongatus*, (Mont.) and young of the *Mytilus edulis*, and the supply is quite sufficient to have served for an extensive manufacture of the dye.

‡ Potter's Archæologia Græca, 6th ed. vol. ii. p. 50.

‡ *Ενδυσαμενος ʾεσθητα βασιλικην.* Acts ch. xii. ver. 21. *Στολην ʾενδυσαμενος εξ αργυρου πεποιημενην ΠΑΣΑΝ.* Josephus, Ant. Jud. lib. xviii. c. 8. § 2.

The shells inhabit all the shores of the Mediterranean, but the best were procured at Tyre, the island of Meninx, the coasts of Getulia and Laconica, and the island of Coa in the Ægean Sea.* The real Murex was fished for and caught with small and delicate nets; a bait was put in them, consisting of cockles or other bivalves, which had been so long kept out of water, that on being thrown in again they gaped widely. The Murex attacked them as food, and was drawn up with them. The other species were found adhering to rocks, on mud banks, &c. The season for catching them was in the spring, when the dye was the deepest and best. It is contained in a small white vein, which lies in the neck of the fish, and in its natural state is a thin and almost colorless liquor. The shell was carefully broken off, and as the dye loses its value when the fish is dead, they were obliged to cut it out alive. The veins were then laid in salt, and left to settle for three days; after which the whole was boiled for ten days more, and the fleshy parts skimmed off as they rose to the surface, till the whole liquid was clear, bright and red. The longer it was boiled, the deeper of course the color became. After this, the wool, well scoured, was steeped in it for some hours, then cleaned and carded, and put in again, to remain till it could absorb no more. Nitre was employed in fixing the color. The hue of the Tyrian dye was of a very deep red, soft and shining; the color of a rose, but approaching to black, or like a very deep shade of the color now called *lake;* of course the word *purple* as at present understood, conveys a wrong impression. When the smaller and inferior species were used, the process was the same, with the exception of their being crushed in the shell, instead of the vein being cut from them. The two were occasionally mixed to produce a variety of shade, according to the fashion.† No mention is made of linen being so dyed, and it seems to have been confined to woolen fabrics, and perhaps, as some think, to cotton. A writer in the Philosophical Transactions of the Royal Society of London,‡ Anno 1684, mentions a person at Minhead, on the coast of Ireland, who made it his business to mark linen with the liquor from shells. From

---

* Plin. Hist. Nat. and Juvenal Sat. ut supra.

† This appears to be the *dibaphos* and *bistinctus* of the Latin writers, and which does not imply that the wool had been twice dyed in the same liquor to produce a deeper shade, as some suppose, but that it was of an entirely different hue. Pliny says such was the most fashionable and the most expensive.

‡ Trans. of the Royal Society, abr'd. vol. ii.

the description and plate given, he appears to have made use of the common periwinkle (*Buccinum Lapillus*, Linn.) for this purpose. On trying the experiment himself, the writer found the color to vary much, and frequently before attaining its final hue. At first it was pellucid and nearly colorless, then became a light green, and if placed in the sun, immediately much darker; in a few minutes it changed to a full sea green, and after that into a watchet blue; in a few minutes more it was a purplish red, and after lying an hour or two became a very deep purple. Further than this the sun did not affect it, but on being washed in soap and water it changed to a very bright and brilliant crimson. When the article dyed with it lay in the sun, it emitted a very strong and fetid smell, as if garlic and assafœtida were mixed together. More lately a species of shell was used by the Spanish Americans at Nicoya, also for dyeing with, but the cloth thus prepared was so expensive as only to be worn by the nobles.* Among the Romans the royal edicts were frequently signed with this liquor, and it was used as a pigment by artists.

In common with the rest of the genus, the fish is carnivorous and locomotive, living sometimes in deep water, and sometimes burying itself in the shore, while it is constantly searching for food. The coloring liquor is probably provided as a means of defense to the animal, as the ink of the cuttle fish, or the saliva of the snail; and although we have never observed the fact in any American or British species, the fish when touched is said to have the power of voluntarily emitting it.† In which case it comes out purple, and of a very rank and offensive odor. If this be so, it must undergo some change in passing through the vein, as when cut out it is white, and long in attaining its purple and final hue. Since the discovery of America, and the introduction of cochineal into Europe, the fish dye has been entirely neglected as an article of merchandise, and is not, that we are aware of, any where used in the present day.

VII. Murex Tritonis, (Linn.)—*Trumpet Shell.*

This fine univalve is indigenous to most warm climates; it inhabits the African, American, and Asiatic seas, and is found on the coasts of the islands of the southern Pacific. The only use it appears to

---

* Rees' Cyclopædia. Article Purple Fish.

† Aristotle, de Hist. Animal. lib. v. cap. 15. Hughes' Nat. Hist. of Barbadoes, p. 272.

be put to, is the making of musical horns or trumpets of it, and for this purpose it has long been used by the natives of Africa and India, and even long before the christian era it was thus employed by the inhabitants of the countries bordering on the Mediterranean. By the ancient Greeks it was universally used for giving signals in war. On the discovery of the Society Islands, it was found to be used in war, by the native priests on solemn occasions, and by the heralds in their ships; it was, in fact, the royal and religious instrument of music, and only made use of as such. The largest shells were selected for the purpose, which in general are about one foot in length. They made a perforation about an inch in diameter, near the apex, and into this they inserted a bamboo cane about three feet in length, which was secured by binding it to the shell by fine cocoa nut braid. The whole was made air tight with the gum of the breadfruit tree. The sound is described as being extremely loud, but the most dismal and monotonous that it is possible to imagine. As late as the last century it was used on board of ships trading to the West Indies or South America instead of a speaking trumpet. A species was also used (and perhaps still is) in Barbadoes, but whether the present one, we cannot from the description determine; it served instead of a bell to call the slaves to their work, and sounded so loud, that on a calm morning it might be heard above a mile off. The apex was merely broken, and then blown through. The fish was eaten, and divers were regularly employed in catching it. They were generally met with in about six fathom water, but after heavy rains they were found at the mouths of the water courses, feeding on the garbage washed down to them. If the water was dimpled so that the bottom could not be seen, the divers poured a spoonful of oil on the surface, which calmed it sufficiently for their purpose. When the tail part, which was somewhat gritty and sandy, was taken away, the rest of the fish tasted like "tripe, but shorter, sweeter, and more luscious." It is this shell which is generally represented in the hands of Triton in pictures, and whence its trivial name;* and from the use to which

* Thus Ovid, speaking of Neptune—

—"supraque profundum
Extantem, atque humeros innato murice tectum
Cœruleum Tritona vocat, conchæque sonaci
Inspirare jubet, fluctusque et flumina signo
Jam revocare dato, cava buccina sumitur illi
Tortalis in latum quæ turbine crescit ab imo."

Ovid, Metamorph. lib. I.

shells were thus put, originated the word *Buccinum*, which among the ancients included at least a third of the known univalves.*

VIII. Murex ——— ?

Another species of Murex (?) was used by the Greeks in preparing a pigment for painters; but the color was obtained from the outside of the shell, and not from the fish, as was the purple dye.†

IX. Ostrea edulis, (Linn.)—*European Oyster.*

Ancient History.—The oyster has probably been used from the earliest periods. As they lie in comparatively shallow water, quickly increase in numbers and size, and offer a very nutricious and refreshing food, we may reasonably suppose that the aborigines of those countries where they are found, were in general well acquainted with them. From Aristotle we learn that the Greeks in his time ate them.‡ It was as early as A. U. C. 633, that the mode of fattening them by laying them in pits and ponds was introduced to Rome. At that time, one Sergius Orata first tried the experiment on the Lucrine oysters, and as he made much money by it and his plan succeeding well, it rapidly spread into different districts. As Rome increased in luxury, the supply from the immediate coasts was not sufficient, and all the shores of the Mediterranean were ransacked for the shell fish. They were frequently brought from a great distance, and at much expense, to be fattened in Italy for the Roman feasts. They abounded at Abydos on the Hellespont;§ but the most celebrated appear to have been procured at Circæum, the Lacus Lucrinus, and from Brundusium. Much however of the fame of these places appears to have arisen from fashion, as we find writers of different times praising as the best those from different districts. The most generally esteemed, however, seem to be those from Rutupiæ, (now Sandwich, in Kent, England,) and which were carried to Italy in great numbers. If we consider the difficulties of

* Dillwyn's Des. Cat. Vol. II. p. 727. Plin. Hist. Nat. lib. XXXII. cap. 11. Ellis' Polynesian Researches, Vol. I. p. 197, where a wood cut of the instrument is given. Hughes' Nat. Hist. of Barbadoes, p. 276. Potter's Archæologia Græca, Vol. II. p. 79, where there is given a long dissertation on the time in which real trumpets were introduced instead of the shells.

† "Concha quæ pictoribus usui est crassitudine plurimum excedit, at florem illum non intra tectem, sed foris habet." Arist. de Hist. Anim. lib. V. cap. 15. *Interpr.* Du Val, tom. ii. p. 844.

‡ Aristotle de Hist. Animal. lib. v. cap. 15.

§ Virgil, Georg. i. 207.

land carriage, and the slowness of sailing vessels in those times, we may form some idea of their price, and the height to which luxury in eating had attained. In later times they appear to have been chiefly used for supper.* That many different species were used is probable. Pliny informs us that those from Circæum (Cape Cieceji) were black both in the flesh and shell, those from Spain reddish, and those from Sclavonia brown and dusky.† It was supposed that the fish fattened during the full moon, and grew thin as it waned; we are not aware that this has been observed in the present day, but it may have happened in particular situations, owing to the difference in the tides. The Roman epicures were in the habit of icing them before eating them, and the ladies used the calcined shell as a cosmetic and depilatory. To the doctors this fish was most valuable, being recommended in a great variety of diseases, and prepared in various ways; and though it could, generally speaking, do no good, it certainly could do little harm.

Modern History.—In England, the oyster fisheries are chiefly carried on at Colchester, in Essex, celebrated for its *green* oysters, at Feversham and Milton in Kent, and in the Isle of Wight. They are also fished for in the Swales of the Medway, in the Tenby on the coast of Wales, and near Liverpool, as well as around Portsmouth, and in many of the creeks of the southern coast. The best are found at Purfleet, the worst near Liverpool. They are very plentifully but partially distributed, and are found to extend further north on the western than on the eastern side of the island. In Scotland they also abound but appear likewise to prefer the north-eastern to the northwestern coast. While they are every where plentiful and highly flavored, from the Clyde to the Zetland, Orkney, and Western Islands, it does not appear that they breed higher on the other side than in the Firth of Forth. Those on the western shores are however comparatively little used, and with the exception of a few sent from Loch Farbert to Greenock, they are consumed by the natives on the spot. Those of the eastern coast, on the contrary, are carried to Newcastle upon Tyne, Hull and London, and have been exported in large quantities to Holland. The best are procured near Preston Pans, Port Seaton, and the Isle of Inchkeith, in Musselburgh bay, Firth of Forth; and vessels from Milton, Lee, and other parts of England come to dredge for them, and carrying them

---

* Juvenal, Sat. vi. 301.

† Plin. Hist. Nat. lib. ix. cap. 32.

away, afterwards fatten them for the English markets. Those from Preston Pans are known by the name of *Pandoors*, as being found at the door of, or near the pans, and from the quantity of fresh water are the fattest and best flavored. In Ireland, Milford Haven is celebrated for its oysters.

Oysters are found on most parts of the French coast, but they are most plentiful on those of Bretagne and Normandy. The most extensive fishery is that which is carried on at Granville, in the bay of which, and for six leagues to the northward they abound. The fishermen bring them to the town and dispose of them to women, who after having fattened them, dispose of them, either pickled or in the shell. Paris, Dieppe and Rouen are chiefly supplied from this place, for which purpose boats are continually arriving from other parts. The oysters from Rochelle and Bordeaux, and generally from the coast of Bretagne, are however by far the most esteemed ; being fatter and more highly flavored, owing to the quantity of fresh water there running into the ocean. Here they are *greened* in the same manner as in England, and require about the same time to come to perfection. They are all to be met with in Paris, but those from Normandy in the greatest numbers. The appetite for shell fish of all sorts, which seems peculiar to the natives of the southern provinces of Italy, is such as to appear exaggerated to a foreigner, accustomed to consider but a few of them as eatable. So great however is it, that at Taranto, the government draws a revenue of twenty four thousand ducats annually from the shell fishery alone. In the Mare Picolo, on which this place is situated, the spawn of the oyster is received on large conical earthen pans, secured at equal distances by ropes tied to them and sunk in different parts of the bay. Their appearance is equally singular and beautiful; the vessel becomes entirely hidden by the shells, when the whole assumes the form of one solid but irregular mass of rockwork. The young oysters being rubbed off are scattered through various parts of the bay, and finally, when sufficiently grown, are collected by means of iron rakes.

Of the quantity of oysters consumed in England, we have no certain or continuous statistics. In 1824, the quantity bred and taken in the county of Essex, and consumed mostly in London, was supposed to amount to fourteen thousand or fifteen thousand bushels. They are at times imported in considerable numbers, but the yearly quantity is subject to important fluctuations. In the season of 1801–2, one hundred and eighty eight British vessels, carrying from six to nine men each, were entered at the custom house of Cancale, in France, and carried back one hundred and nineteen millions four hundred and seventy three oysters, chiefly to London. On an average of 1831—1832, the imports into the same city amounted to fifty two thousand and ninety five bushels a year. In or about 1786, Glasgow consumed twenty thousand annually, which were carried from Leith on horseback or by carts, across the country. The quantity in the present day must be much greater. In 1803, the consumption of Paris was estimated at one million dozen, selling on an average at six sous per dozen.

Natural habits.—The European oyster is smaller, thinner, and more rounded than the American, while the lower valve is less concave or vaulted, it is not beaked, and the fish, compared with the size of the shell, is smaller and of a different flavor; there are besides, various other differences, and their habits are so very dissimilar that there can be no doubt at all of their being distinct species. The European oyster is found only adhering to rocks and stones, or occasionally to very strong clayey bottoms, and should these be washed away, the oyster beds perish. The fish is viviparous, and the young produced with a perfectly formed shell. They are, when first emitted, quite transparent, and they swim with great quickness, by means of a membrane extending out of the shell. So small are they in this state that Van Leeuwenhoek computes that one hundred and twenty of them in a row would extend an inch, and consequently a globular body, whose diameter is an inch, would, if they were round, be equal in size to one million seven hundred and twenty eight thousand of them! The vulgar opinion, and that on which the restraining laws have been framed is, that the period of spawning is May, at which time the young, or *spat*, is found adhering to the rocks. But as the young, as described above, are found in the parents perfectly formed and alive in the month of August, this is most probably the period of parturition, though it be not till May that they become fixed or sufficiently grown to be seen by the common observer. At this time they are about the size of a sixpence, and comparatively hard and firm, and have been well compared to a drop of candle grease in water. In two, or at farthest three years, they are fit for the table. The age to which it attains is probably great, but after having arrived at its full size, the valves are thickened, instead of being increased in length or breadth. From May to July, both the male and female oyster are said to be *sick*, and are in thin and poor condition, but by the end of August they have again recovered, are fat and in season. The sexes are distinguished by the fishermen, by the color of the fringe, that of the male being black, or dark colored, that of the female white. Sand is prejudicial to them; a mixture of fresh water advantageous. The shell, according to Mr. Hatchett, is formed of carbonate of lime and a great proportion of animal gluten, but more intimately mixed, and not lying in regular layers, as in the perlaceous shells.* The oyster frequently contains shining intestinal worms, or animalcules, which may be seen by opening the shell in the dark. A most destructive animal in an oyster bed is the sea-star, (*Asterias glacialis*, Linn.) which clasps its rays round the shell and perseveres till it has sucked out the inhabitant. Another enemy is said to be the muscle, (*Mytilus edulis*, Linn.)

Fishery.—In both England and France the season for fishing for the oyster is restricted by law. In the former country the time allowed for collecting the spawn from the sea is May, when the dredgers may take all they can procure, but after that month they are liable to be convicted of felony if they disturb it, and are only allowed to take such oysters as are the size of half a dollar. The spawn, or *spat*, as it is technically called, is dredged up, and if not too small, they separate it from the shells and stones to which it is adhering, and these they are obliged again to throw into the water to prevent the beds being destroyed. The spat is thrown into creeks or into shallow water on the shores, to increase in size and fatten, and in such situations is considered private property. At Preston Pans the oysters are not *bedded*, but are entirely procured from the sea, and

* Professor Rogers doubts the accuracy of this analysis, as regards the quantity of animal matter contained in this shell, and he supposes that there only exists a very minute portion of gluten. In this opinion he states that he is supported by the experiments of Bucholtz and Brandes, and those he himself made on the *Ostrea Virginica.* What the shells were which were used by the former gentleman, we are not informed; but with all deference we would suggest that he himself seems to have forgotten that the American and British shells are quite distinct species, from which most probably arises the difference he has discovered, and which instead of proving Mr. Hatchett's experiments to be in the main incorrect, only tends to prove that the species are perfectly distinct, and not mere varieties. The quantity of gluten contained in the *Ostrea edulis*, is well known to even the most superficial observer, where the shell is common, and may be found in the large and thick specimens, or on the decaying of the shell, between the inner and outer laminæ, frequently in great quantities. It is of a dirty yellow color, and thick and clammy in its consistency. See Silliman's Am. Jour., Vol. XXVI. p. 361.

in dredging, those which are too small are thrown back again. The season begins on the first of September, and lasts till April. The dredgers make use of a peculiar kind of net, which is very strong, and fastened to three spikes of iron; this they drag along the bottom of the sea, and thus force the oysters into it; each boat requires five men, and they dredge in water from four to fifteen fathoms deep. The *green* oysters are all procured at or in the neighborhood of Colchester. When they wish to give them this color, they throw them into pits dug about three feet deep in the salt marshes, which are overflooded only at spring tides, and to which they have sluices to let out the salt water till it be about one and a half feet deep. These pits become green, and communicate their color to the fish in four or five days, although they commonly let them continue there six weeks or two months, in which time they will become a dark green. The color has recently been ascertained to arise from confervæ, and other marine vegetable matter, decayed by the heat of the sun, on which the animal feeds. A very common and very mistaken opinion exists, especially among foreigners, that not only those, but all English oysters are impregnated with copper, '*which they get from feeding off copper banks;*' such we believe would be quite as injurious to the animal itself as it could be to us, and the fancy can only have arisen from the strong flavor peculiar to this fish. Green oysters are comparatively little esteemed in the present day.

Use.—The great value of this animal is for diet. The shell was at one time supposed to possess peculiar medicinal properties, but analysis has shown that the only advantage animal carbonates have over those of the mineral kingdom, arises from their containing no metallic or foreign substance.* The inhabitants of the shores of Hindoostan did, two centuries since, and perhaps still may, use it in the same manner. The fish is recommended by the doctors where great nourishment and easy digestion are required, the valuable quality being the quantity of gluten it contains. In the northeastern parts of England, old houses may be seen with their tops and gable ends ornamented with these shells, only the inside being exposed; a custom which is said, we know not with what truth, to have been introduced from Holland. In some parts of Scotland the shells are used as manure, and found very excellent and stimulating; in other places they are burned as lime.

---

* Iodine is found in some of them.—*Ed.*

In 1768, Mr. John Canton discovered that a very good phosphorus* could be made from oyster shells. He added a little sulphur to them, and by calcination produced the substance. A long account of the process and his experiments is given in the Philosophical Transactions of that year. The French have a proverb drawn from this animal, which they apply to an awkward person, "*il parle ou joue, &c. comme une huitre á l'écaille.*"†

Besides these, oysters are found in most countries; the following are a few of the species.

The West Indies have, according to Hughes, two oysters, a large one in deep water, which is seldom eaten, and the mangrove oyster, which adheres to the roots of the trees in the wash of the tide, whence the old fable of oysters growing on trees. The same are found in Sumatra, where we are told that they are by no means so good as those of Europe.‡ Round the shores of New South Wales oysters are extremely plentiful, and though generally small, are of delicate flavor. Every rock is covered with them, and Mr. Martyn informs us he has seen parties of young ladies, with small hammers, seated on a large rock and feasting with great *goût* on these dainties.§ In Southern Africa the oysters of Mossel Bay are much celebrated, and their flavor considered so fine, that epicures have been induced to visit the bay from Cape Town, (Cape of Good Hope,) for the express purpose of enjoying a feast of them. The distance is about three hundred miles, so that they ought to be good to repay the trouble.||

X. Ostrea Scabra, (Linn.)—*Scaly Oyster.*

This is an inhabitant of the Bahama islands, where it is eaten. It is occasionally to be met with in the Philadelphia markets for the same purpose.

---

* So called from its emitting light in the dark after exposure to the sun's rays.—Ed.

† In compiling this article, the following works are those which have chiefly been referred to and quoted from:—Plin. Hist. Nat. lib. xxxii. cap. vi. lib. ix. cap. 36. Rees' Cyclopædia, Art. Oyster. McCulloch's Comm. Dict. Art. Oyster. Brewster's Edinburgh Encyclop. Art. Fisheries. Encyclop. Americana, Appendix, Vol. viii. Art. Oyster. Postlethwaite's Diction. Art. Oyster. Sinclair's Stat. Hist. of Scotland, Vol. i. p. 358. Vol. vi. p. 196. Vol. x. p. 202. Vol. xvii. pp. 69, 102, &c. Keppel Craven's Tour, p. 184. Statistique generale, &c. par. P. E. Herbin, Vol. i. p. 386. Diction. de Trevoux. Philosophical Transactions, Vol. viii. 554. lviii. 337. ii. 606, &c. &c. &c.

‡ Marsden's Hist. Sumatra, p. 121.

§ Martyn's Hist. of the Br. Col. Vol. iv. p. 295.

|| Webster's Voyage to the S. Atlantic Ocean, 1830, Vol. i. p. 223.

XII. Mya Pictorum, (Linn.)—*Painters' Gaper,*

Is common to many of the rivers of Great Britain and the north of Europe. It was formerly made use of for holding the colors employed by artists, whence its trivial name; but for the last thirty or forty years it has, we believe, been entirely neglected for this purpose, and is now only to be met with in collections.

XII. Turbo littoreus, (Linn.)—*Whelk.*

This shell is common to most of the shores of Great Britain, but is perhaps most plentiful on the limestone rocks, on the northeastern coast of England, where it lives in common with the periwinkle, below high water mark: it is gathered by children and old men, and retailed, boiled, in small measures, in the streets of the seaport towns. They are never very abundant, and may be considered rather as an humble luxury than an article of food.

The periwinkle, (*Buccinum Lapillus*, Linn.) though so nearly resembling it, and more common, is not, that we are aware of, ever used in the present day, though it formerly was, as Holinshed tells us: "We have in like maner no small store of great whelkes and perewinkles, and each of them brought farre into the land from the sea coaste in their severall seasons."*

XIII. Pecten maximum, (Penn.)—*Great Scallop.*

This shell is found on most of the coasts of Great Britain and Ireland, particularly on those of Portland and Purbeck in Dorsetshire, and near Yarmouth in Norfolk. The fish is eaten, and in some parts it is pickled and barreled, and in this state is the object of a small commerce. Holinshed mentions them as being extensively used in Henry VIII. and Queen Elizabeth's reigns, and they are still cooked in various ways, and considered a luxury. The fish was formerly supposed to be medicinal, and recommended by the doctors as "detersive, aperitive and carminative," and the shell was also administered in the same manner as that of the oyster. At a still earlier period it was worn by pilgrims, and thence found its way into armo-

---

* Holinshed's Chronicles, Lond. Ed. 1807, Vol. i. p. 378.

rial bearings.* It was, however, properly speaking, peculiar to the Compostella pilgrimage. Popes Alexander III, Gregory IX, and Clement V, granted in their bulls a faculty to the archbishop of Compostella, that they might excommunicate those who sold these shells to pilgrims any where except in the city of Santiago; and the reason assigned is, that the scallop shell is the badge of the apostle of Santiago or St. James.† They were occasionally carved as cameos. The shell lies in large beds, in moderately deep water, and is procured by dredging. In common with the other species, they are locomotive, and have the power of springing or leaping, by which they move themselves. They effect this by suddenly forcing the under valve against whatever they lie on, and so raise themselves a few inches at a time. The only value which the shell has now, is for its occasional, but well known use as a substitute for a dish.‡

XIV. Pecten opercularis. (Penn.)—*Small Scallop.*

This shell, though smaller and less common than the former, is occasionally used as food on the southern coasts of England. Its habits are the same as the last, and the shell is not put to any use.§

XV. Pecten concentricum, *American Scallop,*

Is found along the whole coast of the United States, from Maine to Florida. It does not appear to be very generally used as food, but is occasionally to be met with in the New York markets and oyster cellars for that purpose.

Of this genus many more species are most probably used as food in different countries, as when large enough they are always easily obtained, wholesome and palatable.

---

* "The scallop shows in a coat of arms,
That of the bearer's line,
Some one in former days hath been
To Santiago's shrine."—*Southey's Pilgrim. Introd.*

† Southey's Pilgrim. to Compostella, Notes, pp. 208—217, where various traditions of the origin are given.

‡ Donovan's Br. Shells, pl. 49. Holinshed's Chron. Vol. ii. p. 378, and James' Medical Dictionary, Vol. iv. Art. Pecten.

§ Murray's Encyclopædia of Geography, Art. England. Transactions of the Linnean Society of London, Vol. viii. p. 99.

XVI. Voluta gravis. (Linn.)—*Chank.*

These shells form a considerable article of trade in Hindoostan, where they are in extensive demand all over the country. They are sawed into narrow rings, and are worn as ornaments for the arms, legs and fingers, by the Hindoo women. Many of them are likewise buried with the bodies of rich and distinguished persons. They are fished up by the pearl divers in the Gulf of Manaar, and elsewhere in India, in about two fathoms water. The fishery is monopolized by government, who most commonly let the banks for as much as four thousand pounds sterling per annum, but the trade is free. When the Dutch held possession of Ceylon, the fishery was open to all, but the trade to Bengal was a monopoly in the hands of the Company. A chank, opening to the right, called in Calcutta the *right handed chank*, is so highly prized as sometimes to sell for four hundred, five hundred, or even one thousand rupees, or about five hundred dollars, American currency.*

XVII. Cypræa Moneta. (Linn.)—*Money Cowry.* Hindoostanee *Kapardakas*—Guinea Coast, *Timbis.*

This little shell is indigenous both to the East Indies and the western coast of Africa. In the former they are chiefly found on the shores of the Lacadive and Maldive islands, and are thence imported into Calcutta and Bombay. In both continents they are used as a circulating medium, and in India they pass current in the British presidencies, but for very low values. In Calcutta two thousand five hundred and sixty cowries are worth one current rupee, or about fifty cents; but there are several intermediate and nominal coins, the lowest worth four of these shells. They are, however, quickly disappearing from commercial transactions where Europeans are settled. Previous to the abolition of the slave trade they were largely imported into England, to be subsequently used in Africa, and though the quantity is much diminished, they are still to be found in the price currents of London and Liverpool. In Peale's museum at Philadelphia, there is a singular head dress of scarlet cloth, entirely studded with these shells, which is said to have been brought from China.†

* McCulloch's Commercial Dictionary, Article Chank. Diction. Univers. de la Geographie, par J. Peuchet, Art. Ceylon.

† McCulloch's Commercial Diction. Art. Cowries and Calcutta. Martyn's Hist. of the British Colonies, Vol. i. p. 357. Vol. iv. p. 589. Kelly's Univ. Cambist, 2d Ed. Vol. i. pp. 88 and 166.

XVIII. Chiton fasciatus? (Linn.)—*Beef Shell.*

The only instance, we believe, of any species of this genus being used, is the present, at the island of Barbadoes, where they are cooked for the table. We are told that the fish is of a pale red color, (whence its provincial name,) and that "it is very firm eating, short and well tasted." It is about one and a half inches in length, and three quarters of an inch in breadth. It appears to be abundant, and living on the rocks, is easily obtained. The shell is useless.*

XIX. Murex despectus. (Linn.)—*Rock Whelk.*

This, the largest of the British univalves, is not uncommon on most of the coasts of Great Britain. It is occasionally drawn up with oysters, but we have most frequently obtained it from the ground lines of the fishermen, to the baits of which it adheres. In common with the rest of the genus, it is carnivorous. It is occasionally eaten, but being coarse food, is more generally used as bait.†

XX. Solen Siliqua. (Linn.)—*Razor Shell.*

This shell is found in abundance on many of the sandy shores of England, especially on the northern and western coasts, and on those of Scotland and Ireland. The ancients esteemed them, when cooked, as a delicious food, and Dr. Lister informs us that he thought it nearly as rich and palatable as the lobster. In England and Scotland, in the present day, it is more used as bait than for the table, but in Ireland it is still much eaten during Lent. It is in season during the spring, and the shell is of no value. It is eaten likewise by the inhabitants of the Crimea, bordering on the Black Sea, on the shores of which it is plentifully found.‡

XXI. The operculum of a species of shell is understood to have been used in making the sacred perfume of the Jews, the substance called in the Hebrew *specheleth,* and which in the English version is

---

* Hughes' Natural Hist. of Barbadoes, p. 275.

† Donovan's British Shells, plate 31.

‡ Ib. plate 46. Histoire physique, morale, civile et politique de la Russie moderne par M. Le Clerc, Vol. iv. p. 291.

translated *onycha*,* and by the LXX. *onyx*. Dioscorides and Rumphius both describe the shell. It is found in the marshes of India, where the Nard (*Andropogon Nardus*, Linn.) grows, on the leaves of which it feeds, and is thence said to obtain its peculiar odor. The shells are gathered in the summer, when the heat has dried up the water; and it serves as the basis of all perfumes throughout the east. According to its etymology, (ονυξ) *onyx* signifies the nail of the finger or toe, which the substance resembles, and which, according to the Greek tradition, was so called from its being the parings of Venus' nails, cut off by Cupid with one of his arrows. The best was procured from the shores of the Red Sea, which was white and large: the Babylonian was black and smaller, and therefore probably from a different species of shell.†

XXII. Mytilus edulis. (Linn.)—*Edible Muscle.*

This shell is common to most parts of the world, being met with in each of the four continents, and we believe in Australasia. Specimens from different places certainly do differ, but so slightly, and so much the same are their habits, that a scientific naturalist finds it impossible to separate the species by any decisive mark.

In the warm climates they grow to a larger size, and their flesh is more nutritive, than in the cold. They lie in large beds in shallow water, and adhere to each other or to foreign substances, by means of the byssus, which is particularly strong, but they are probably locomotive, at least when young. They succeed the best when always under water, but will also live on rocks only covered at high tide. They are generally used for the table, and make perhaps the best bait known for fishing. In England they are chiefly eaten by the poorer classes on the coasts, and seldom carried into the interior; in Lancashire, however, they have been planted in the river Weir like oysters, where they grew fat and delicious. They are plentiful on most of the coasts of France, both in the Atlantic and Mediterranean, and are commonly used not only in the maritime departments, but also in Paris; and although they are seldom admitted to the tables of the higher classes, the consumption of them is very considerable. In the neighborhood of Rochelle they are kept to fatten in

* Exodus, ch. xxxi. v. 34. Dictionnaire de Trevoux, Vol. iv. Art. Onyx.

† Calmet's Dict. of the Holy Bible, Art. Onycha. Scripture illustrated by means of Natural Science, Vol. iv. p. 45.

salt water ponds, (*Bouchots*) into which a certain quantity of fresh water is allowed to enter; by which means they are improved both in size and flavor. They are in season in the autumn.

In Italy, where, owing to the frequent fasts, shell fish enter more largely into the food of the people than elsewhere, this species is extremely plentiful. The sandy bed of the Mare Piccolo, on which stands the town of Taranto, is literally blackened by the muscles which cover it. The boats that glide over its surface are laden with them; they emboss the rocks which border the strand, and appear equally abundant on the shore, piled up in heaps, or packed in carts. They spawn on ropes, which are tied at intervals to poles stuck in the water, and these, when drawn out, exhibit the semblance of massive festoons of carved ebony, or brilliant black coral. When about the size of a small bean, they are plucked from the ropes, and scattered in different parts of the bay, whence, at the period of perfection, they are collected by means of iron rakes and sent to market. They are generally to be met with in the New York markets, but the consumption is not large, neither is the fish so excellent as the European: they are common on the oyster beds and other parts of the bay. The shell differs from the British species in being flatter, not so much ridged, more angular, more extended at the larger end, more polished on the outside, and it seldom grows so large or thick, but it is probably only a variety. Some parts of the fish (and at certain seasons all) are unwholesome, and there are instances where death has been caused by eating them: the shell was formerly in England occasionally used in a somewhat similar manner as that of *Mya Pictorum*, but otherwise it is of no value.

Where they abound, the European oyster is *said* to be destroyed by them, but this is not yet thoroughly proved. In Scotland, they are particularly plentiful on the western coast, and in some places are considered private property, and a revenue raised from them by making the fishermen pay a species of tax, or fixed rent for the quantity taken. They are enumerated by Holinshed among the shell fish in use in his time, and are in the present day eaten by the inhabitants of the shores of the Black Sea.*

---

* Donovan's Br. Shells in loco. Hon. R. Keppel Craven's Tour through the Southern Provinces of the kingdom of Naples, pp. 183—4. Sinclair's Statist. Hist. of Scotland. Herbin's Statistique generale et particulière de la France, &c. Vol. i. pp. 384—6. Holinshed's Chronicles, Vol. i. p. 378. Le Clerc's Histoire de la Russie, Vol. iv. p. 291.

XXIII. Cardium edule. (Linn.)—*Edible Cockle.*

This common English shell inhabits the low sandy and muddy shores of most parts of Great Britain, and is found a little above low water mark. The specimens lie singly, about a foot deep in the sand, and like the *Mya arenaria* of this country, their locality is known by a dimple or depression, of about half an inch in diameter. They are dug out. They are likewise found on some of the French coasts, and in both countries are used for the table; but their consumption is entirely confined to the more humble and poorer classes. In the sixth century they were however of much more importance, and eaten by all. In general they are prepared by simply boiling them, after having been kept a few days in fresh water to get quit of the sand they contain.

In the island of Barry, on the coast of Inverness, Scotland, this fish is at times the chief support of the inhabitants, and so plentiful are they there, that in seasons of scarcity the people have subsisted solely on them for months together. The popular opinion there is, that they spring from small animalculæ, brought down by the water springs from a certain green hill in the neighborhood of the sands. Buchanan, the Scottish historian, gives a somewhat similar account of their origin, as being believed in his time throughout Scotland. Except the occasional burning of the shell as lime, or applying it as manure, it is of no value. They are in season during the spring.*

XXIV. Helix Pomatia. (Linn.)—*Edible Snail.*

Luxury perhaps attained to a greater height in ancient Rome than in any other country of which we have the history. Not only was there the most lavish splendor and magnificence in the houses and the temples; not only were these met with in the dress and equipages, but the most minute attention and refinement was applied to the science of cookery and to the table. The present shell is an instance of this: not content with eating animals as they were by nature, the greatest ingenuity was manifested in feeding and fattening them, and while Rome was mastering or holding in subjection

* Sinclair's Statistical Hist. of Scotland, Vol. xiii. p. 336. Holinshed's Chronicles, Vol. i. p. 378.

one half the known world, thousands of birds were slaughtered to procure one dish of tongues, rivers turned from their course, and mountains cut through, to form oyster pits and lamprey stews, and patricians and senators thought it not beneath their dignity to superintend the minutiæ of snail warrens. This shell is indigenous to most parts of continental Europe, but it chiefly abounds in Italy and Spain. In the former it anciently was, and still is, much used for the table, and among the Roman epicures there was constant competition to prove who could produce the largest and the fattest. Pliny informs us that one Fulvius Harpinus was the first who invented a stew for snails about B. C. 80, in which they were fed and protected. Every care was taken of them, and the owners of these warrens boasted as much of their snails, as gentlemen, in the present day, do of their horses. Several species, from various countries, were probably used, each of which were kept in separate departments, and were regularly fed on wheat meal sodden with wine and mixed with a few laurel leaves. Thus preserved, they grew to a most surprising size, and if we can believe the authorities, it was not uncommon for the shell, (naturally about two inches in diameter,) to contain ten quarts of liquid!

The *Cochlearia*, or snail stews, were generally made in open places surrounded by water, so that the snails might not abandon them, and care was taken that the places were not too much exposed to the sun or the dews. The artificial stews were most frequently made under rocks whose bottoms were watered by lakes or rivers, and if there was not a natural dew, they produced one by means of a pipe of water bored full of holes. They were also fed on a smaller scale, in large pots or pans, bored full of holes to let in the air, and lined with bran and wine lees or vegetables. In Italy they are still fed in similar places on vegetables, and during Lent are eaten in great quantities. They are regularly exposed in the markets, as well as in those of Switzerland, Spain, and France, and are exported in barrels to the Antilles. They were introduced into England about two centuries since, and distributed through the counties of Surrey and Sussex, but by whom is now uncertain. They soon spread themselves, however, through most parts of the south, and are found at present in the country round Dublin. In the north they have never prospered, and we are not aware of any place more northerly than Northamptonshire, where they are to be found. In Holstein they are indigenous as far as the shores of the Baltic, and are the most common snail of that country; but neither there nor in England are they used for the table. In France they are the objects of a small commerce; the peasants collect them in the vineyards, and feed them till winter, when they seal themselves up, and in this state they are purchased by the confectioners, who prepare them in the shell with butter and herbs, and forward them to Paris. They are recommended in pulmonary complaints, and are used by the ladies as a cosmetic. The French have a proverb drawn from this shell, which they apply to an ill formed or decrepid person—"*il est fait comme une escargot.*" They are found in the Crimea, where they are eaten by the Tartars.*

The *Helix Aspersa*, (Muller,) was introduced into England by Sir Kenelar Digby, for the relief of those affected with diseases in the lungs, but is not, that we are aware of, now ever used.

XXV. Unio ———?—*Fresh water Muscles.*

This most abundant and interesting American family, though every where found, appears to be but little used. Some tribes of Indians eat them, and at present round one of the ponds at Plymouth, Mass., may be seen pits full of these shells, the fish of which had been consumed by the aborigines before the landing of the Pilgrims. Some of the thicker species of the Ohio, are said to have been at Pittsburgh successfully turned into buttons and ornaments resembling mother-of-pearl.

XXVI. Chama Gigas, (Linn.)—*Boat Shell.*

This very fine and well known bivalve is chiefly found in the Bay of Tappanuli, in Sumatra; but is sufficiently plentiful around New Guinea, and in other parts of the east; it lies in moderately deep water, and frequently grows to a very large size. One shell described by Linnæus weighed four hundred and eighty nine English pounds, and he says the inhabitant has been known to furnish one hundred and twenty men with a day's food. Sir Joseph Banks had an

---

* Plin. Hist. Nat., lib. ix. cap. 32. Donovan's British Shells, Vol. iii. Pl. 84. Dictionnaire de Trevoux, Art. *Escargot.* Le Clerc's Hist. Mod. de Russie. Statistique de France, Vol. i. pp. 387–388. Say's Am. Conchology, *Helix. Introd.* The information respecting the Romans, is chiefly from Varro, *De Re Rusticâ*, a copy of which the writer has not been able to meet with, and has therefore drawn his information from extracts. Those who have it in their power to consult the original, will, he believes, find more extended information on the subject.

account of one which weighed five hundred and seven pounds; the largest valve measured four feet six inches in length, and two feet five inches and a half in breadth, and one foot in depth. Large pearls are occasionally found in them; the same gentleman once exhibited one which was valued at between nine hundred and twelve hundred dollars; a large shell of this sort is used as a baptismal font in the church of St. Sulpice, at Paris, and was presented by the Venetians to Francis the first. The shell is worked by the natives of Sumatra into arm rings and other ornaments, and in the hands of their artists is found to take a polish equal to finest statuary marble. It is several inches thick, and perfectly white, and might probably be used to advantage in some of the finer arts in this country. One of the methods of taking them is by thrusting a long bamboo between the valves as they lie open, when by the immediate closure that follows, they are made fast. The name for this shell in the language of Sumatra is *Kīma*, whence probably our word.* It is this shell in which Neptune is represented in pictures to be riding.

XXVII. Cameos or *Camaieux*, are in the present day frequently made from shells. The word properly applies to the onyx stone, whether cut or not, and which is formed of layers of different colors, so that when cut the ground appears of one hue and the figure of another. The derivation of the name is *Camehuia*, an oriental word, signifying *another stone*, or *one stone placed on another*. The shells employed are from the Mediterranean, but we have not been able to ascertain the species—the genus we understand to be *Venus*. The outer coat is white, the interior layers dark red, and being very hard, admit of a fine polish. They are cut with the lapidary's mill. The substitution of shells for stones, appears to be a very modern invention. False cameos are made of pieces of glass of different colors luted together, and afterwards either cut or cast, according to the figure. It is these which are now so common and sold at so low a price.†

XXVIII. Shells have long been used by the ladies in making fancy work; sixty or seventy years since, this was particularly the fashion in Europe, and large *grottos*, on which extravagant sums had been expended were not uncommon, besides a multiplicity of fancy

---

* Dillwyn's Des. Cat. Vol. I. p. 215. Marsden's History of Sumatra, 3d ed. pp. 15, 121.

† Chalmers' Commercial Dictionary. Dictionnaire de Trevoux, Art. Onyx.

work in shells of all sorts. Mr. Hughes, in his History of Barbadoes, has two folio pages, vindicating the ladies against the imputation of extravagance and waste of time in their passion for this shell work, but his argument goes rather to prove that this pursuit is *more* improving than many others which the fair sex of his time followed, than that it is altogether such as ought to engross their minds to the extent it did. Though this taste is disappearing, shells are still in this country made into fancy baskets, vases, ornaments for head dresses, &c., the manufacture of which is chiefly carried on as a real art, and for profit, and as such, is of course as valuable, as far as it goes, as any other branch of ornamental industry. Articles thus made are admitted for competition at the fairs of the American Institute in New York.* Though all species are occasionally used, the principal seem to be the rice shell, (*Voluta oryza,*) the rose shell, (*Cypræa sulcata? immature,*) the green shell, (*Nerita viridis,*) some species of Tellina, &c. &c. from the West Indies. At Taranto, shell work is a regular business, but the articles are chiefly pictures, resembling mosaic work, picture frames, &c. The shells are stuck one by one, according to their shades, upon paste board, on which lines have previously been drawn. The articles are very expensive, and being of course of little use, they are purchased rather as curiosities than otherwise. There are also some manufactures of a like nature in France.†

XXIX. Some of the Indian tribes west of the Rocky Mountains make use of various colored shells, ground to an oval, or nearly round shape, as a circulating medium. The same use is made by the Indians of the eastern coast of wampum, or strings of beads cut from the *Venus mercenaria,* (Linn.) and other shells, as well for a register of events, or history of their nation. The Indians likewise use the wampum as instruments of treaty, and as *speech belts,* or letters to convene a meeting of the Sachems, when such is required for consultation.‡

The New Zealanders use shells and beads of mother-of-pearl as necklaces, bracelets, and amulets, and also stud their baskets and

* At the October Fair, 1836, a diploma was granted by this Society "for a beautiful shell miniature church." Journal of the Am. Institute, Vol. II. p. 196.

† Hon. Keppel Craven's Tour through the Southern Provinces of Naples, p. 184. Hughes' History of Barbadoes, &c.

‡ Hunter's Manners and Customs of several Indian Tribes, p. 302. Marshall's Life of Washington, 2d ed. Vol. I. notes, p. 3—4.

aprons with the same.* Being beautiful, and easily obtained, we find shells used by most savage nations as ornaments, and frequently as instruments and utensils for cutting with, drinking from, &c.

XXX. The Brehmins of Hindoostan make their astronomical observations, by means of shells arranged before them on the ground, and the Egyptians and even the ancient Greeks are said to have used shells in counting and calculations.†

XXXI. At Mobile, shells are used in mending the roads, for which purpose they are said to answer well.

XXXII. By some of the aborigines of the coast of South America, a large bivalve, full of grain, was buried with the body, to feed it during its travels to the next world.

XXXIII. The stony operculum of some species of East Indian *Turbo*, are used in this country as '*eye stones*,' to remove dust, etc. from the eye.

XXXIV. Bivalves were used by the Greeks and Romans in the ostracism, the name of the person to be banished being written on the shell. Whether the Romans ever made use of shells for this purpose has been doubted; though at first they perhaps might, and afterwards only the earthenware tiles, to which the Greek name *οστρακον* was transferred.

ART. IV.—*Criticisms and suggestions respecting Nomenclature;* by ROBERT HARE, M. D., Prof. of Chem. in the Univ. of Pennsylvania. *Also, a letter from the celebrated* J. J. BERZELIUS.‡

TO THE EDITORS OF THE JOURNAL OF PHARMACY.

Philadelphia, March 4, 1837.

Dear Sirs—In September, 1833, I published in your Journal, together with some encomiums upon the treatise of Chemistry by the celebrated Berzelius, certain objections to his nomenclature, and some suggestions respecting a substitute, which I deemed to be preferable. In the following June I addressed a letter to Professor Silliman upon the same topics, in which my criticisms and sugges-

* Cook's Voyages, 3d ed. 4to, Vol. I. p. 219, &c. where plates of these articles are given.

† Playfair on the astronomy of the Brehmins, in Transactions of Royal Society of Edinburgh, Vol. II. p. 135. Herodotus, lib. ii. cap. 36.

‡ Copied from the American Journal of Pharmacy, April, 1837.

tions were amplified and corrected in obedience to more mature reflection. A printed copy of that letter having been sent by me to Berzelius, I received in answer an epistle, of which I furnish you with a translation.

Since the period of that correspondence, so demonstrative of candor and good feeling on the part of the great Swedish chemist, I have published two editions of my Compendium of Chemistry, in which I have pursued a course corresponding with my criticisms above alluded to. I am therefore desirous, in addition to the letter of Berzelius to lay before the public a recapitulation, a review, and an additional explanation of the grounds upon which I have ventured to employ a language, and an arrangement inconsistent with the practice and opinions of a chemist by whose authority in other respects I am usually influenced. But before proceeding with the ungracious task of endeavoring to establish the correctness of my views in opposition to those of my friend, I feel that it will be no more than justice to repeat an acknowledgment, already made in my text book, that if De Bonsdorff, myself, and others are right in considering the *double* salts of Berzelius as *simple* salts, it is to the light afforded by his investigations, that we owe the power of seeing the subject correctly. I believe the idea, that any other body besides oxygen could produce both acids and bases capable of forming salts, originated with Berzelius, in the instance of sulphur.

Recapitulation and review of the grounds of his deviating from the language and arrangement of Berzelius, and other distinguished chemists; with some additional explanations and suggestions, by R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

According to the Berzelian nomenclature, bodies which produce salts by a union with radicals are called *halogen* or *salt producing bodies*, while those which with radicals form both acids and bases, capable by their union of constituting salts, are called *amphigen bodies* or *both producers*. Salts, produced by the first mentioned class are called haloid salts; those produced by the other are called amphide salts.

I objected to this classification, that the words *salt*, *acid* and *base*, were broad, vague and unsettled in their acceptation, having, by chemists in general, and especially by Berzelius, been employed to designate substances differing in composition, and extremely discordant in their properties; that no method of defining a salt had been devised, which had not been founded either on properties or composition; that in the nomenclature of Berzelius properties were disregarded, since among his haloid and amphide salts were found substances, differing extremely in this respect. Thus, for instance, common salt Glauber's, salt, Epsom salt, vitriolated tartar, and cream of tartar, were associated with the fuming liquor of Libavius, the butyraceous chlorides of zinc, antimony, and bismuth, plumbum corneum, luna cornea, fluor spar, and the acid fluorides of silicon and boron. I objected also that composition could not be resorted to consistently with his classification; since, agreeably to it, a salt might be either a binary compound of a halogen body with a radical, or consist of two binary compounds, each containing the same amphigen body.

To the terms *acid* and *base*, as employed in his nomenclature, I objected, that neither by the celebrated author, nor by any other chemist had any definition been adhered to which could, consistently with his plan, restrict the meaning of those appellations to the binary compounds formed by the union of his amphigen bodies with radicals.

Acidity and basidity* had sometimes been distinguished by an appeal to properties, sometimes to composition, but to neither had there been any consistent attention. In order to demonstrate the total neglect of properties latterly displayed, it was only necessary to contrast substances bearing generally the name of acids; as for instance sulphuric acid with rock crystal, acetic acid with tannin, and prussic acid with margaric; or to contemplate simultaneously the admission of the hydracids formed with the halogen bodies into the class of acids, while alleged incapable of combining with bases, with the exclusion from that class of nitrous acid, upon the plea of the same incapacity.

In reference to neglect of composition in forming the class of acids, it will be sufficient to advert to the association in that class, of compounds formed with radicals both by the halogen and amphigen bodies; so that the halogen bodies are in one case producers of salts, in the other producers of acids; in one case act as supporters, acidifiers, or electro-negative principles, in another as radicals to the comparatively electro-positive hydrogen, pre-eminently a radical by

* For the use of the words basidity and salidity, I have no authority; but conceive that through their analogy with acidity, their meaning is so obvious as to make it expedient to employ them.

the definition of that word given in the treatise of the distinguished author of the nomenclature.

After stating my objections to the basis of the Berzelian nomenclature, I proceeded to mention those to which I considered the superstructure as liable.

Having designated the acid compounds of his amphigen class, by prefixing syllables indicating their electro-negative ingredients; having also in some instances, as in those of the fluosilicic, and fluoboric acids, adopted this course in relation to halogen bodies; I objected to the use of the word hydracid, in which the electro-positive radical is made to act as if coordinate with oxygen.

Moreover, the termination in *ide* having been generally attached to the electro-positive compounds of oxygen, acting as bases, I condemned the employment of that termination, to distinguish the electro-negative and acid compounds of sulphur, selenium, and tellurium. I considered it inconsistent to give precedence to the syllable designating the radical in the acids formed with hydrogen; as in hydrochloric, hydrobromic, hydriodic, hydrofluoric, hydrofluoboric, hydrofluosilicic, preferring the terms chlorohydric, bromohydric, iodohydric, fluohydroboric, fluohydrosilicic, &c., in which I have been sanctioned by Thenard and others.

I proposed a definition of an acid and a base, which I conceived to be the only one which could be adopted, consistently with the use made of those words by Berzelius, and other distinguished chemists; and advanced that, agreeable to that definition, his double haloid salts must be considered as *simple* salts, severally formed of an acid and a base.

I objected to his treating the words combustion and oxygenation as synonymous.

Having thus made the reader acquainted with the substance of my criticisms upon the Berzelian nomenclature, I will subjoin his letter in answer to them, and will then state, and endeavor to justify, the conclusions at which I have arrived.

Letter from Prof. J. J. Berzelius of Stockholm to R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania, acknowledging the receipt of a communication respecting Nomenclature, and replying thereto.

Stockholm, September 23, 1834.

Sir—I am very much obliged to you for the remarks, which, under the date of June 21st, you had the friendship to communicate to me respecting the nomenclature which I have employed in my Treatise of Chemistry.

I perceive that having contemplated chemical phenomena under different points of view, we differ as to the nomenclature which is the most appropriate for their description. I consider the combinations of metals with chlorine, bromine, &c., as salts; whilst you, in accordance with Mr. De Bondsdorff, consider them as bases and acids, capable of forming salts by their union.

If it were expedient that chemical classification should be dependent on the number of simple bodies which enter into each combination, this idea of Mr. De Bondsdorff would without doubt be preferable; but if attention be due to the chemical properties which characterize combinations, we cannot adhere to an arrangement founded on the number of the elements. Yet so essential is it in chemistry to have reference to properties, that a system of chemistry in which common and analogous properties should not affect the arrangement, would present a mass of facts so chaotic, that no memory would be competent to retain them. In a system thus strictly conformable to the ideas of Mr. De Bondsdorff, cyanogen, though in its properties resembling chlorine or bromine, which are simple bodies, ought to be considered, also, as a base or as an acid, having azote for its radical—I am persuaded you would not approve of extending the system of De Bondsdorff so far; but if it be correct, it would be inconsistent not to make this extension.

But let us return to the combinations of the metals with chlorine, fluorine, &c., and make, in imagination, the following experiment. Let us take two portions of caustic potash, a base in which the *basic* characters are more striking than in any other. To one, let us add a sufficiency of sulphuric acid to extinguish entirely its *basic* property; we shall then have a neutral body of a saline taste. You will admit it to be a salt. Now let us add to the other portion, hydrofluoric acid. At a certain point the *basic* properties of the potash will disappear, and we shall have a resulting compound quite as neutral as the sulphate of potash, endowed with a saline taste entirely analogous to that of the sulphate. The basic properties of the potash are destroyed by the hydrofluoric acid, as well as by the sulphuric acid. But you will allege the resulting combination is not a salt, but a base which has exchanged one basifier (oxygen) for another basifier (fluorine.) In proof you may add as much more hydrofluoric acid, which combining with the new base will form with it a crystallized salt. But this salt is not neutral, it has almost the same acidity of taste as the hydrofluoric acid employed. The new base does not destroy then the acid reaction.

Let us make a further addition of sulphuric acid to the sulphate of potash. A salt equally acid will result, in which the sulphate of of potash acts the same basic part towards the sulphuric acid, as the fluoride of potassium towards the hydrofluoric acid. Should it be desired to extend the comparison further, it will be found that for each less electro-positive fluoride, susceptible of combination with the potassic fluoride, there will be, with but very few exceptions, a corresponding sulphate, susceptible of combination with the sulphate of potash. The analogy is then complete, it exists not only in the perfect neutrality of the two potassic salts, in their saline taste, but also in their manner of forming combinations with other bodies; notwithstanding one of them, the sulphate, contains one element more than the other. If, instead of potash, potassium were employed to saturate our two acids, the analogy of the operation in both cases, would be still more complete. The same quantity of metal would displace equal volumes of hydrogen. When the visible results of our experiments are so perfectly analogous, it is to be presumed that the invisible process which we do not see, may also be perfectly analogous, and that if facts exactly alike are explained differently, there must be a defect in the explanation. If, for instance, the true electro-chemical composition of the sulphate of potash should not be $KO+SO^3$, as is generally supposed, but $K+SO^4$,* and it appears very natural that atoms, so eminently electro-negative as sulphur and oxygen, should be associated, we have, in the salt in question, potassium combined with a compound body, which, like cyanogen in $K+C^2N$,† imitates simple halogen bodies, and gives a salt with potassium and other metals. The hydrated oxacids, agreeably to this view, would be then hydracids of a compound halogen body, from which metals may displace hydrogen, as in the hydracids of simple halogen bodies. Thus we know that SO^3, that is to say, anhydrous sulphuric acid, is a body whose properties, as respects acidity, differ from those which we should expect in the active principle of hydrous sulphuric acid.

* In the Berzelian symbols, K stands for kalium, or potassium, S for sulphur, O for oxygen, and O^3 for three atoms of oxygen, O^4 for four atoms of oxygen.

† That is to say, if the salt called sulphate of potash, be considered as compound of potassium, and a quadroxide of sulphur, instead of being viewed as a protoxide of potassium, or potash, and tritoxide of sulphur, or sulphuric acid. This is the formula for cyanide of potassium, consisting of potassium, K, and cyanogen, or two atoms carbon and one of nitrogen, C^2N.

The difference between the oxysalts, and the halosalts is very easily illustrated by formulæ. In K|FF—fluoride of potassium, there is but one single line of substitution, that is to say, that of K|FF, whilst in KOOOOS (sulphate of potash) there are two, K|OOOOS and KO|OOOS of which we use the first in replacing one metal by another, for instance, copper by iron; and the second in replacing one oxide by another.

I do not know what value you may attach to this development of the constitution of the oxysalts (which applies equally to the sulphosalts and others:) but as to myself, I have a thorough conviction, that there is therein, something more than a vague speculation; since it unfolds to us an internal analogy in phenomena, which, agreeably to the perception of our senses, are externally analogous. If these phenomena are to be considered agreeably to the ideas of Mr. De Bondsdorff, how does it happen that sulphur, phosphorus, arsenic, and other radicals of the strongest oxacids, when united with chlorine, bromine, iodine, &c., do not combine with chlorides,* bromides, &c., of the metals of the alkalies and of the earths; whilst the chloride and bromide of potassium combine easily with those of magnesium, iron, and manganese. Should then the chloride of magnesium, or that of manganese, be a stronger acid than the chloride of sulphur, or chloride of phosphorus? How is it consistent with these ideas that we can obtain crystallized salts as well with, as without water, of combination, composed of chloride of calcium and of oxalate, or of acetate of lime? Should the oxysalt be here the acid, or the base? I have now displayed to you, the considerations which have guided me, and which I think are not destitute of foundation.

I cheerfully admit that it would be preferable to employ the word chlorohydric, instead of hydrochloric. My motive for retaining this last, is, that I have ventured to propose a new nomenclature in a language foreign to me, in which it was inexpedient to make changes which could be avoided without inconvenience. I also agree with you, that we ought not to use combustible and oxidable, as having the same meaning. I have deserved your strictures for this inconsistency in my language; but I must suggest as an apology, that the two words were formerly used as synonymous, and that the work, in which you have recently noticed this oversight, was first published in 1806, having been from time to time remoulded for new editions,

* I have translated chlorure, fluorure, bromure, by chloride, fluoride, and bromide, agreeably to the practice of the British chemists.

without its having been possible to eradicate all that has not kept pace with the progress of science.

Accept the assurance of my perfect esteem, and of the sentiments of sincere friendship with which I have the honor to be, Yours, &c.

An Examination, by the Author of this Article, of the Suggestions in the preceding Letter of BERZELIUS, *and how far the Objections made to his Nomenclature are therein answered.*

So far as my strictures were founded on the alleged difficulty of defining the terms acid, salt and base, in any mode consistent with his classification, they are not met by any facts or reasoning in the much esteemed letter of my illustrious correspondent. The impracticability of defining a salt, he does not deny; and with great candor he admits that, in his definiton of acidity, he has not been consistent. He concedes that it would be preferable to give the syllable, indicating the electro-negative ingredient, the precedence, as nothing but unwillingness to innovate, prevented him from pursuing that course.

He acknowledges that as combustion, in many instances, takes place without the presence of oxygen, the application of the word combustible, should not be confined to bodies which are susceptible of oxydizement.

My definition of acidity was as follows:—

"*When, of two substances capable of combining with each other so as to form a tertium quid,* and having an ingredient common to them both, one prefers the positive the other the negative pole of the Voltaic series, we must deem the former an acid, and the latter a base. Also all substances having a sour taste, or which redden litmus, must be deemed acids, agreeably to usage.*" This definition I would now amend by leaving out the last sentence, and substituting therefor, the following: *Also when any substance is capable of forming a tertium quid with any acid or base agreeably to the preceding definition, it must be considered as an acid in the one case, a base in the other.* The definition, thus amended, takes in the organic acids and bases. In the form in which it was at first proposed, it has not been alleged defective by Berzelius; but he has striven to show an incongruity in the attributes of his double salts, when contrasted with those resulting from the union of some of the acids and bases of his

* This term *tertium quid* has been used by chemists, more formerly than of late, to designate a compound resulting from the union of two bodies, but in its properties resembling neither.

amphigen class; which incongruity is, in his opinion, a sufficient reason for not considering them as *simple* salts, and their ingredients as acids and bases, agreeably to the opinions of De Bondsdorff and myself.

Berzelius errs in confounding my opinions with those of De Bonsdorff. However I may have admired the sagacity with which that chemist investigated the pretensions of some haloid salts to certain attributes of acidity or alkalinity; in my letter on the Berzelian nomenclature, I signified my unwillingness to rest my opinions upon a basis so narrow, as that which he had endeavored to establish. I stated that I did not deem it necessary to appeal to his excellent observations, proving certain attributes of acidity to exist in one case, those of alkalinity in the other. I alleged my definition to be founded on the conviction that the property of affecting vegetable colors, on which that sagacious chemist lays so much stress, has not latterly, been deemed necessary in acids; and that in bases never was required. As respects them, it only served as a mean of subdivision between alkaline oxides and other oxibases.

I am at a loss to discover in what part of my letter there was any language which could convey the erroneous impression, that, in defining acids and bases I proposed to overlook properties, and to be regulated by attention to the number of atoms in a compound. Certainly nothing was more foreign to my thoughts.

It is assumed by Berzelius that the saturation of the fluobase of potassium by fluohydric acid, cannot be considered as analogous to the saturation of the oxybase of potassium by sulphuric acid; because the resulting compound is to the taste, in one case neutral, in the other sour. In reply I suggested that if the salidity of the biborates and bicarbonates was not to be questioned on account of their alkaline taste, nor that of the protochloride of tin on account of its sourness, it was not consistent that the pretensions to salidity of the fluohydrate of the fluobase of potassium should be denied on account of its sour taste. I will now add that if the fluosilicate of potassium be a double salt, the fluoride of silicon one of its two constituents must be a simple salt, and yet it is sour. If a simple salt may be sour, why may not a double salt have this attribute; and how in fact can its presence be inconsistent with salidity? Is not the absence of this characteristic in silica and tannin, and many other acids, as much against their claims to acidity, as its presence in other compounds is an objection to their association with saline bodies. It is considered by Berzelius an objection to the views which I have espoused, that the halogen bodies, while forming acids with various metallic radicals which oxygen does not acidify, do not form acids with sulphur, phosphorus, and arsenic which oxygen does acidify; yet what is there in this, more difficult to reconcile with the established results of chemical combinations, than in the fact that oxygen forms with sulphur, phosphorus, and arsenic, strong acids, with hydrogen water; while with hydrogen the halogen bodies all form compounds which Berzelius describes as having the highest pretensions to acidity. The highly active acid properties of the fluorides of boron and silicon, would lead us to expect similar compounds to be formed by the same radicals, with the other halogen bodies, contrary to experience. Chemistry makes us acquainted with many similar discordances. How is it that oxygen forms aëriform compounds with an extremely fixed body in the instance of carbon; while in that of phosphorus or arsenic, both volatilizable, it forms acids which are comparatively insusceptible of volatilization? Wherefore does not hydrogen produce an acid with phosphorus and arsenic, as well as with sulphur?

According to Berzelius, all the halogen bodies produce with hydrogen combinations which are as highly endowed with the attributes of acidity, as the strongest acids into which oxygen enters as a constituent. It is conceded in his letter that his language respecting these combinations cannot be reconciled with his declaration in one place that they do not combine with oxybases, and in another that a body which cannot so combine is not an acid. It strikes me, that the only way in which the admitted inconsistency of his description of these bodies, with his definition of acidity, can be avoided, is by assuming that they combine as acids with haloid bases, although decomposed by oxybases.

I will now proceed to comment on a new subject for consideration, presented in Berzelius's letter in reply to mine.

It must be evident that every oxysalt, composed of an oxacid and an oxybase, must consist of an atom of each radical, and as many atoms of oxygen as exist both in the acid and in the base. Thus sulphate of potash consists of an atom of potassium, an atom of sulphur and four atoms of oxygen, and may be represented either by SOOO KO or SOOOOK.

Berzelius in his letter repeats an ingenious suggestion previously advanced in his treatise, that SOOOO, (sulphur with four atoms of oxygen,) may act, as a compound halogen body like cyanogen, and thus form a salt by union with an atom of any radical. He conceives that the apparent want of analogy, which induced him to separate into two classes, the amphigen and halogen bodies, disappears under this view of the phenomena; and that his amphide salts might be considered as constituted of a compound halogen body and an elementary radical. But however we may admire the ingenuity of these suggestions, ere, in obedience to them, we extend the limits of the halogen class, I would request that the word salt should be defined, and that it be shown that consistently with any definition which can be devised, there is any class of bodies in nature which merit the appellation of salt producers. Before enlarging the superstructure, let it be shown that the basement has been well grounded.

Berzelius lays some stress on the community of effect, in the evolution of hydrogen, both by acids formed by hydrogen with halogen bodies, and by diluted hydrous sulphuric acid, as evincing a similitude of composition justifying the suggestion above quoted from him. But I conceive that this common result is better explained by ascribing it to the tendency of radicals to displace each other from combination, whether existing in a simple or a complicated compound. If water exists as a base in hydrous sulphuric acid; as I have elsewhere suggested, we may consider this hydrous acid as a sulphate of the oxybase of hydrogen; and that when it reacts with zinc or iron, the proneness of hydrogen to the aëriform state enables either metal to take its place, agreeably to the established laws of affinity.

It may be proper, before concluding, to explain more particularly the nomenclature which I have adopted.

The amphigen, and halogen bodies of Berzelius as they produce acids and bases according to my definition, are all classed as basacigen bodies. Of course oxygen, chlorine, bromine, iodine, fluorine, cyanogen, sulphur, selenium and tellurium, are included in this class.

The general designation of a binary compound of a basacigen body, is the termination in *ide;* the special, the termination in *acid*, when the compound acts as an acid, in *base,* when it acts as a base.

Hence an oxide, may be an oxacid, or an oxybase;

a chloride,	a chloracid,	or a chloribase;
a bromide,	a bromacid,	or a bromibase;
an iodide,	an iodacid,	or an iodobase;
a cyanide,	a cyanacid,	or a cyanobase;
a sulphide,	a sulphacid,	or a sulphobase;
a selenide,	a selenacid,	or a selenibase;
a telluride,	a telluracid,	or a telluribase;

Compounds which consist of radicals only, are distinguished by the term *uret* equivalent to the French *ure*. Hence *carburet, phosphuret, boruret, silicuret, &c.*

Of any two binary compounds containing each the same basacigen body and forming one compound, the more electro-negative is an acid, the other a base. Hence all the electro-negative haloid compounds in the Berzelian double salts, are acids, and the electro-positive, bases. Where there are two such compounds one containing one basacigen atom, the other two atoms or one and half, the former has a termination in *ous*, the latter in *ic*. As for instance the *chlorureplatinosopotassique* of Berzelius, is a compound of *chloroplatinous acid*, and the *chlorobase of potassium*, and is the *chloroplatinite of potassium*. The *chlorureplatinico-potassique* of the same author, is the *chloroplatinate of potassium*.*

By analogy the intelligent reader may easily make these examples a clue to designate any other of the double salts of Berzelius so as to accord with the plan in question. He may have a *bromoplatinate*, or *bromoplatinite*, a *iodoplatinate* or *iodoplatinite*, a *fluoplatinate*, *&c.;* or exchanging the radical a *chloroaurate* or *chloroaurite*, a *bromoaurate* or *bromoaurite, &c.*

The terms amphigen and halogen being employed both from expediency, and in honor of their author, we may use his terms haloid and amphide, to distinguish the acids or bases severally formed by these classes, the abbreviations *halo* and *amph*, being employed in composition. Thus I designate the acids formed by the halogen bodies with hydrogen, as halohydric acids; those formed with that radical by the amphigen bodies, as amphydric acids. As the same radical will in other cases be found to form acids with several of the halogen bodies, platinum for instance, the acids thus produced, may be called haloplatinic aids; or if gold were the radical, they would be called haloauric acids. These examples will suggest to the chem-

---

* In designating salts of the metals proper, as for instance, the *nitrate of mercury;* the idea of the oxydisement of the metal is always understood, although usually not expressed. In the instance above cited, we actually mean the *nitrate* of the *oxide* or *oxybase* of mercury. By analogy, I here use the term *chloroplatinate of potassium*, for *chloroplatinate* of the *chlorobase* of *potassium*. It is in fact, well known to chemists, that acids do not unite directly with metals. The only alleged exception to this rule, of which I have any knowledge, is that of tellurium and sulphuric acid. It is inferred, therefore, that when an acid is combined with a metal, the latter must exist in the state of a base formed with the basacigen body which enters into the composition of the acid.

ical reader a series of names, as for instance *haloargentic*, *halocupric*, *halostannic*, *halopalladic*.

I consider prussian blue as a cyanoferrite of the cyanobase of iron, or briefly a cyanoferrite of iron. The diversity of properties which enables two cyanides of iron to exist in combination in this cyanoferrite, one as an acid, the other as a base, is one among many other instances in which compounds constituted of the same elements in the same ratio, have different properties, and are said in consequence to be *isomeric*, or to afford cases of *isomerism*.

The salt designated by Berzelius as the " *cyanure ferroso-potassique*," is the well known test for iron heretofore called ferroprussiate of potassa; under the idea that it consisted of prussic acid, iron, and potassa. As the prussic acid was viewed at the same time as a compound of hydrogen and cyanogen, the ferroprussic acid was considered as a compound of cyanogen, hydrogen, and iron. According to Berzelius, the supposed *ferroprussiate* is a compound of a "*protocyanure*" of iron, and a "*cyanure* of *potassium;*" each being a simple haloid salt, and the aggregate a double " *cyanure*." Agreeably to my nomenclature, the "*protocyanure*" of iron is considered as cyanoferrous acid, and the " *cyanure*" of potassium as a cyanobase; the aggregate being a cyanoferrite of the cyanobase of potassium, but designated briefly as a cyanoferrite of potassium.

I infer that the "*ferroprussic*" acid is analogous in constitution to the triple compound of fluorine, silicon and hydrogen, improperly called hydrofluosilicic acid; and that, consistently with the hypothetical views under which the latter received its name, the former should be called hydrocyanoferric acid. Even admitting the correctness of the hypothetical impression, to which I have alluded, agreeably to which such compounds are acids with a double radical, I urged that the appellations of such compounds should be so altered as to give precedency to the electro-negative ingredient. Hence the one would be called cyanohydroferric acid; and the other, fluohydrosilicic acid. But in my letter to Prof. Silliman, already cited, I advanced a new hypothesis respecting the constitution of the fluohydrosilicic, and fluohydroboric acids. I suggested that they should be considered as compounds in which the fluorides of silicon or boron acted as acids, the fluoride of hydrogen as a base. Consistently with that doctrine, I would consider the *protocyanide* (or "*cyanure*") of iron in the alleged *ferroprussic acid*, as acting as *cyanoferrous acid*, the *cyanide* of *hydrogen* (*prussic acid*) as a *cyanobase* forming, by their union, a cyanoferrite of hydrogen.

As compounds, consisting of a basacigen body, hydrogen and a radical, do not, when presented to bases, enter into combination; but are on the contrary, decomposed so as to allow another radical to take place of their hydrogen, it is inconsistent with chemical law, as stated by Berzelius,* or my definition of acidity, (page 9,) to designate them as acids.

I have called the electro-negative "*protocyanure*" of iron of Berzelius, cyanofer*rous* acid, because there is "sesquicyanure" in the "*cyanureferrico-potassique*" of that author, which by analogy with the nomenclature of the oxacids, is entitled to the appellation of cyanoferric acid.

Art. V.—*Description of an Electrical Machine, with a Plate four feet in diameter, so constructed as to be above the Operator: also of a Battery Discharger employed therewith: and some Observations on the Causes of the Diversity in the Length of the Sparks erroneously distinguished by the terms Positive and Negative;* by R. Hare, M. D., &c. &c. &c.

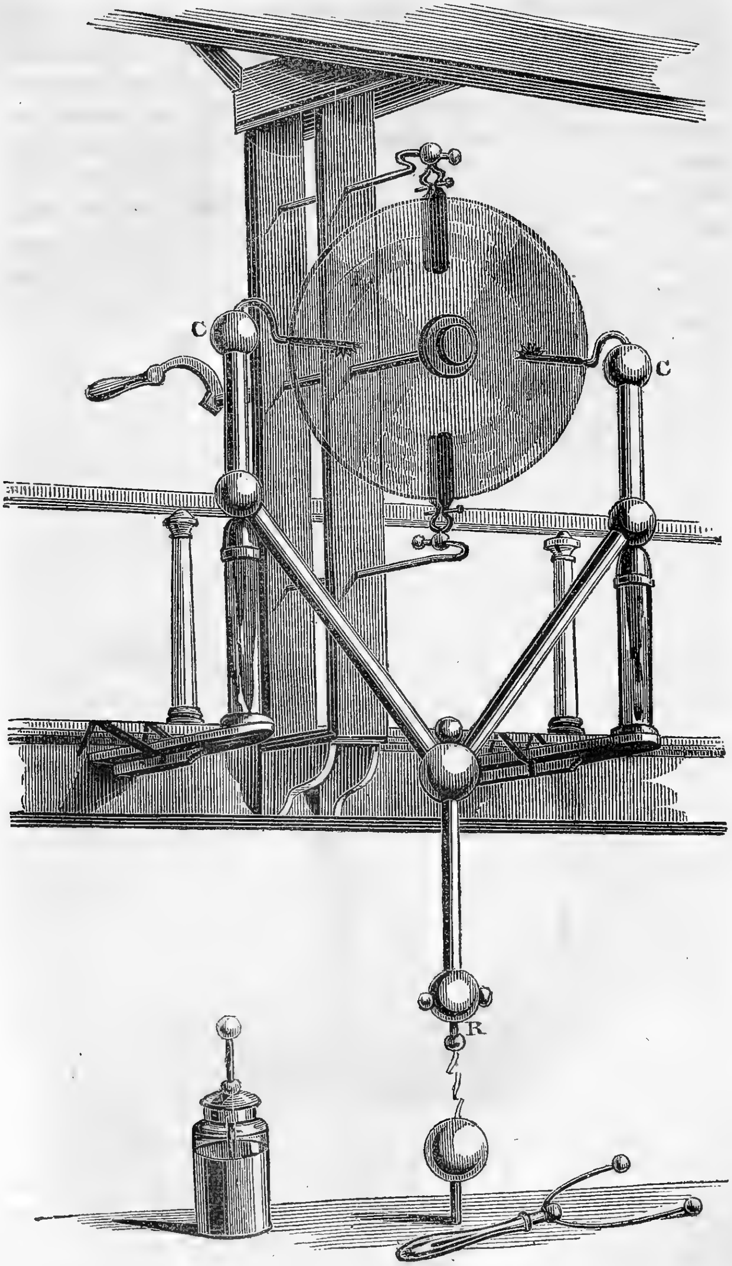
The opposite engraving represents a machine with a plate four feet in diameter, which I have recently constructed so as to be permanently affixed to the canopy over the table of my lecture room.

This situation I have found convenient even beyond my expectations, as the machine is always at hand, yet never in the way. In lecturing, with the aid of a machine on the same level with the lecturer, one of two inconveniences is inevitable. Either the machine will occasionally be between him and a portion of the audience, or he must be between a portion of the audience and the machine. Situated like that which I am about to describe, a machine can neither hide the lecturer, nor be hidden by him. With all its power at his command, while kept in motion by an assistant, he has no part of it to reach or to handle besides the knob and sliding rod of the conductor, which are in the most convenient situation.

The object of this machine being to obtain a copious supply of electricity for experiments, in which such a supply is requisite, it was not deemed necessary to insulate the cushions and the axis, as in the electrical plate machine which I employ for experiments requiring insulation.†

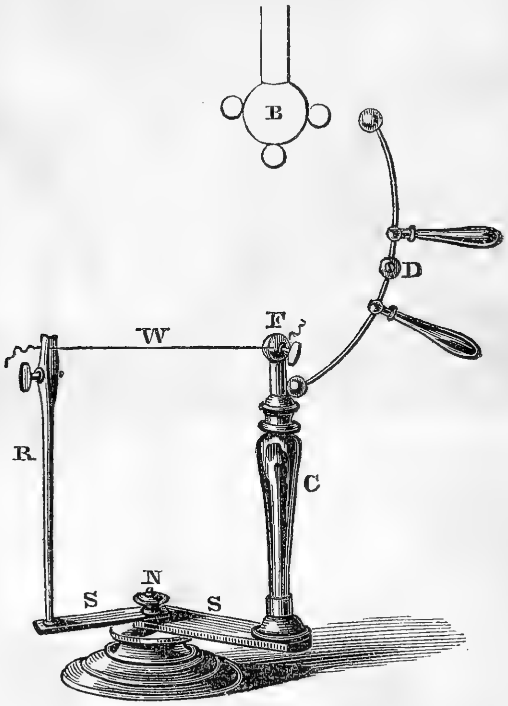
* Traite, page 41, vol. ii.

† See this Journal for 1828, vol. vii, p. 108; or London Phil. Mag. for 1823, vol. xxiii, p. 8.


C
C
R

The prime conductor is supported and insulated by means of wooden posts covered by stout bell glasses, so that the summits of the latter are between those of the posts and the inner surfaces of caps attached to the conductor. By these means the glass is subjected to pressure, but is liable to no strain. Such a support combines the advantages both of wood and glass. At C C, are the collectors. R represents a sliding rod, which may be drawn out to such an extent as to be brought in contact with any apparatus placed under it upon the table. In fact, the large rod in which the rod R slides may be slipped up to any elevation through the hole in the brass ball which sustains it.

Dr. Hare's Battery Discharger for deflagrating wires.



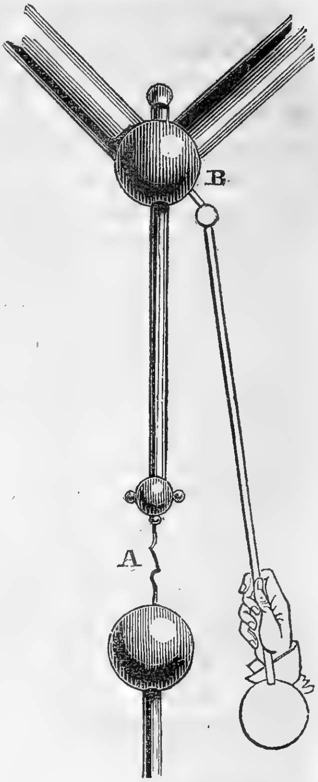
The instrument represented by the preceding figure, is employed by me in lieu of Henley's universal discharger; being better adapted to my apparatus, and mode of operating. Two brass plates, S S, are secured to the pedestal by a screw bolt N, which passes though a hole made in each, near one extremity: the plates are thus allowed a circular motion about the bolt, so as to be set in one straight line, or in any angle with each other. On one of the plates near the extremity not secured by the bolt, a brass socket is soldered, into which a glass column C is cemented, surmounted by a forceps. At the corresponding end of the other plate, there is a brass rod R, perpendicular to the plate, and parallel to the glass column. This rod is also furnished with forceps. Between these forceps, and those at F, supported and insulated by the glass column C, a wire is stretched, which may be of various lengths, according to the angle which the plates S S make with each other. The pedestal should be metallic, or have a metallic plate at bottom, in communication with the external coating of the battery. This being accomplished, it is only necessary to charge the battery, without subsequently breaking the communication between the inner coatings of the jars, and the prime conductor, by which the charge is conveyed. In that case, touching the conductor, is equivalent to a contact with the inner coatings of the jars, so far as electrical results are concerned. Hence, by causing one of the knobs of the discharger D, with glass handles, to be in contact with the insulated forceps F, and then approximating the other knob to the prime conductor B, the charge of the battery will pass through the wire W, as it cannot descend by the glass column, nor reach the operator through the glass handles. These should be longer than represented in the cut.

Long zigzag or erratic spark, contrasted with the short straight spark.

"The cause of this difference between the lengths of the two electricities, we have no means of explaining."—*Thomson's work on Heat and Electricity.*

The object of the engraving on the following page is to represent the different forms and lengths of the electric spark, which take place between a large and a small ball, accordingly as they are made negative or positive. The long and zigzag, or erratic spark A takes place between a small ball attached to the positive pole, and a large one associated with the negative pole. The short straight spark B is elicited under circumstances the reverse of those just mentioned. They are represented as simultaneous, but with the same machine, can of course, only be obtained in succession.

In no respect do the phenomena of mechanical electricity appear more favorable to the Franklinian theory, and more inexplicable, according to the doctrine of two fluids, than in the diversity of the electrical spark in passing between a small and a large metallic ball,



according to the manner in which the balls are associated with the positive or negative poles of the machine. When the small ball is attached to the positive pole, the spark is long, comparatively narrow, and of a zigzag shape, such as lightning is often seen to assume; but when the situation of the balls is reversed, the spark is straight and thick, not one third as long, and nothing of a zigzag shape can be observed in it.

According to the Franklinian theory, when any body is more highly charged with electricity than the adjoining bodies, the excess of the fluid is attracted by them, while it is inadequately repelled by the inferior quantity of the electric fluid, with which they are imbued. It follows that when a small globe is made positive in the neighborhood of a large one, the excess of electric matter in the former, is attracted by all the negatively excited metal in the latter. When the small globe is made negative the metal of which it consists attracts all the electric matter in the large globe. Hence there is this difference in the two cases; the small globe being positive, a comparatively small *movable mass* of electric matter, is attracted by a large immovable mass of metal: the small globe being made negative, a large *movable mass* of electric matter is attracted by a small immovable mass of metal. The charge being in both cases the effect of the same machine; the attractive power must be as great in one case as in the other. The forces by which the masses are actuated being therefore equal, it is quite reasonable that the greatest projectile power should be attained, when the small mass is movable. In that case, it will require less air to be removed in order to effect a passage.

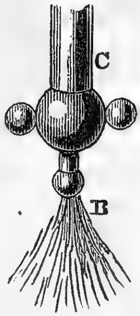
There is an analogy between the difference which I suppose to exist in the case under consideration, and that which may be observed between the penetrating power of a rod which is blunt, and one which is pointed.

It remains to show why a large mass of electric matter will be discharged in a spark when there is sufficient proximity, although that electric matter be situated in the large globe, and attracted by the other, under circumstances in which, as above stated, it would not pass without that proximity.

It must be evident that attraction increases, as the distance between the bodies which exercise it lessens. Of course the attraction of the small globe must always act more powerfully on those portions of the electric fluid, which occupy the nearest parts of the positively excited globe. But this difference of distance, and consequent diversity of attraction, increases as the globes are approximated. Thus that portion of the electric fluid which sustains this pre-eminent attraction, will be accumulated into a conoid; the acuteness of which, and attraction causing the acuteness, increasing with the proximity, there will at last be sufficient projectile and penetrative power to break through the air, and thus open a passage for the whole of the quantity attracted by the small negatively excited globe.

When, by the process last described, the fluid is made to leap through a comparatively small interval, by the concentrated attraction exercised by a small negative ball upon the extensive surface of the electric matter diffused through a large globe, the air does not become sufficiently condensed to resist it before it reaches its destination, and, of course, it cannot assume the erratic form which would arise from repeated changes in its course, as in the instance of the long spark.

Of the Electrical Brush.



When the machine is in active operation, and the prime conductor insulated; from a small knob attached to it, as at B, in the figure, the electricity will be sent off, as by the concomitant light to exhibit the form of a luminous brush, as represented in this figure at B. For the production of this phenomenon, it is necessary that the electric fluid shall be condensed into a small prominent mass, so as, agreeably to the preceding explanation, to have great penetrating power. This it cannot possess, when, with the same intensity in the generating power, a large ball is positively electrified. In that case, the electric column presents a front too broad to procure a passage through the surrounding non-conducting air. A small ball, negatively electrified, can only be productive of a diffuse attraction for the electricity in the atmospheric medium around it; so that it has less ability to create any penetrating power, than when acting upon the electricity in a comparatively large globular conductor, as in the preceding illustration. Hence, when the knob is on the negative pole, it may be productive of a luminous appearance in its immediate vicinity, where the electric matter, converging from the adjoining space, becomes sufficiently intense to be productive of light; but it does not produce the striking appearance of the luminous brush.

As, agreeably to Du Fay's theory, the knob, whether vitreously or resinously electrified, is surcharged with an electric fluid, the projectile power ought to be as great in the one case as in the other; and the long spark and the brush should be producible in either case.

On some Inferences from the Phenomena of the Electric Spark, in a recent work on Heat and Electricity.

In his valuable work on heat and electricity, Dr. Thomson states that if a long spark be taken between two knobs, as when severally attached to the positive and negative conductors of the electrical machine; the portion of the spark near the positive knob exhibits all the characters of positive electricity, while the remaining portion proceeding from the other knob displays all the characters of negative electricity. Although the learned author does not state what differences there are between the different portions of the spark, and wherefore, if any exist, he can, without a petitio principii, assume that they are such as to justify his conclusion; he proceeds to allege that there can be no doubt that every spark consists of two electricities; and that these, issuing severally from their respective knobs, terminate their career by uniting at the non-luminous portion of the spark, which is at a distance from the negative knob of about one third of the interval. Upon these grounds he infers that the positive electricity occupies two thirds of the length of the spark, the negative one third.

I presume that, agreeably to the theory which supposes the existence of two fluids, when the equilibrium between oppositely excited surfaces is restored by a discharge, whether in the form of a spark or otherwise, there must be two jets or currents passing each other; the one conveying as much of the resinous as the other does of the vitreous electricity. Of course no part of a spark can be more negative than it is positive, nor more positive than it is negative. Hence I do not approve of another suggestion of the same author, that the diminution of light near the middle of the spark results from the combination of the different fluids at this point. It appears to me that there is as little ground for supposing the union of the fluids to take place there as elsewhere. But admitting that the union does take place as supposed, is this a reason for the observed diminution of light? If, when isolated, either fluid is capable of emitting a brilliant light, should not their co-operation increase the effect? If, after their union, they do not shine, it can only be in consequence of their abandoning, at that moment, all the light with which they were previously associated. It cannot be imagined that the light accompanying one should neutralize that accompanying the other.

In deflagrating, by voltaic electricity, a wire of uniform thickness, equally refrigerated, the most intense evolution of heat and light is always midway.

In truth, the theory which the learned author sanctions, requires two postulates so irreconcilable, that unless one be kept out of view, the other cannot be sustained. It requires that the fluids should exercise an intense reciprocal attraction, adequate to produce chemical affinity, and of course, enter into combination when they meet, and yet rush by each other with inconceivable velocity, not only through the air, but also through the restricted channel afforded by a small wire. If the fluids combine at a point intervening between the surfaces from which they proceed, what becomes of the compound which they form? Is it credible that such a compound would afford no indication of its existence? But, again, how are two surfaces, the one previously deprived of a large portion of the negative electricity naturally due to it, the other made as deficient of the positive fluid, to regain their natural state? By a combination midway, the resinous and vitreous surcharges might be disposed of, but whence could the vitreous and resinous deficiencies be supplied?

Dr. Thomson, in common with the great majority of modern chemists, ascribes chemical affinity to the attraction between the two electricities combined with ponderable particles. As the combinations between such particles take place only in definite proportions, would it not be consistent that the fluids which give rise to them, should combine agreeably to those laws? But if the electrical compound, formed of the vitreous and resinous electricities, be decomposable by induction, as the theory in question requires, its constituents must be capable of uniting in every proportion.

Agreeably to the late investigations of the celebrated Faraday, equal quantities of the electric fluid are evolved by analogous chemical changes, in equivalent weights of different ponderable bodies. It may therefore be inferred, that in entering into combination the electric fluid is obedient to those laws of definite proportion which regulate other substances.

It may be imagined, perhaps, agreeably to the undulatory theory, that the undulations produced at the non-luminous point are such as to destroy each other. But this I conceive would be a surmise requiring proof, rather than a fact on which to found an opinion.

Art. VI.—*Of an Improved Barometer Gage Eudiometer;* by Prof. R. Hare, M. D., &c. &c.

About nine years ago* I published an account of a hydro-oxygen eudiometer, in which the measurement of the gases was effected by means of a barometer gage. In the apparatus then employed, the receiver was of glass, and was, of course, fragile. Subsequently I employed a stout iron bottle in lieu of the glass.

The essential constituents of this apparatus are an air tight vessel, sufficiently strong, and having screw apertures for the insertion of valve cocks, V V V, a thermometer T, and a galvano ignition apparatus† W W; also a barometer gage G, communicating by a leaden tube with the vessel through one of the valve cocks.

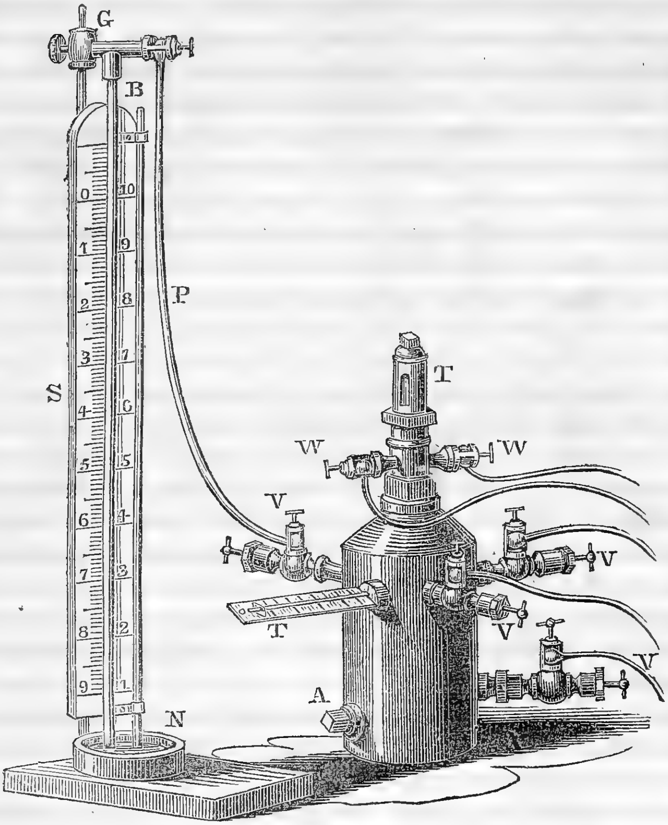
An air pump, pneumatic cistern or trough, and reservoirs for gas, are necessary auxiliaries.

It is an important characteristic of the barometer gage eudiometer, that it is applicable on a much larger scale than any other. It is only necessary to make the requisite apertures, and tap them for appropriate screws, in order to transfer the valve cocks, thermometer and ignition apparatus, with all the essential means of operating, to any air tight cylinder of any size; to a large cannon for instance, the mouth being closed. The sources of inaccuracy, if any exist, must lessen in proportion to the result, as the quantity acted upon is augmented. It would, of course, be safer to extend the cylinder in length than in diameter.

---

* The reader of the article then published, will excuse some repetition, as otherwise the apparatus in its improved form could not be made intelligible to those who have not seen, or do not remember the explanation then given.

† This is the name by which I have designated it in my text book.



Description of the Gage.

It is well known, that if a vertical glass tube communicate, through its upper orifice, with a receiver, while its lower orifice is situated beneath the surface of an adequate quantity of mercury, in any convenient receptacle; on exhausting the receiver, the metal will rise in the bore of the tube in proportion to the quantity of air removed. Hence, if zero of the ascending column of degrees, counting upwards from one to ten, be placed on a level with the surface of the mercury in the receptacle at the foot of the gage tube G, the quantity of gas liquefied or withdrawn will be as the number of degrees opposite the surface of the column of the mercury in the gage tube.

Again, supposing it were possible to exhaust the vessel perfectly, the column of mercury in the gage, would attain the height of a well filled Torricellian tube. By having such a tube by the side of the gage tube, as represented at B in the figure, its orifice communicating with the mercury of the same receptacle, and placing zero of the descending column of graduations on a level with the surface of the mercury in the Torricellian tube, the quantity of air in the receiver will always be as the number of degrees, between the surface of the mercury in the gage and the surface of the same metal in the Torricellian tube.

The scale comprises ten divisions, each containing ten subdivisions. The whole scale may therefore be estimated to divide the capacity of a receiver into ten volumes, or into one hundred, whenever the zeros of the right and left hand columns of degrees coincide simultaneously, the one with the surface of the mercury in the receptacle, and the other with that of the Torricellian column. But on this it were vain to rely, since the altitude of the Torricellian column is liable to vary while the scale remains unchanged. This difficulty is, however, easily surmounted by restricting the length of the graduated part of the scale to the minimum height of the mercurial column, or twenty-seven inches; and employing an excess of hydrogen when the quantity of oxygen is to be ascertained, and an excess of oxygen when the quantity of hydrogen, or hydrogen and carbon, are in question; the excess in either case, being made equal to the difference between twenty-seven inches, and the height of the Torricellian column. With this precaution, the quantities introduced or withdrawn, will always be to each other as the changes which they produce in the column of mercury in the gage tube. The rise of the mercury in the tube, will cause the surface of it in the receptacle D to be lower; but the breadth of this vessel is so great, and the descent of the mercurial surface in it is so inconsiderable, that no error worthy of attention is thus created.

I ought to mention, that the cavity of the gage tube ought to be so small in proportion to that of the receiver, as to create no error worthy of attention.

Description of the Galvano Ignition Apparatus.

An iron cylinder, of about an inch in bore, includes another concentric cylinder, or tube of glass. A platina wire, which, by being made the subject of a galvanic discharge, is employed to ignite the gaseous mixture, occupies the cavity of the glass. Opposite to it, two openings are made in the iron, which serve for windows, enabling the operator to see the progress of the ignition, and consequently, to know when to break the galvanic circuit, in order to avoid fusing the wire.

Method of Operating.

In the engraving, a leaden tube is represented as making a communication between the gage tube and the cavity of the iron bottle, through one of the valve cocks. Let it be supposed that, by means of other valve cocks and tubes, like communications with an air pump, and one or more reservoirs of gas, are under the control of the operator.

In order to analyze the atmosphere, he should have at his command a communication with a bell glass containing, over water, a mixture of five parts of air and three of hydrogen; also with a reservoir of hydrogen.*

These arrangements being made, exhaust the bottles; and admitting two or three volumes of hydrogen, exhaust again. By repeating this part of the process, nothing but hydrogen will remain in the vessel. Let the zero of the descending scale be situated on a level with the surface of the mercury in the gage tube, and then admit eight volumes of the mixture, which will be known to have entered when the surface of the mercurial column has fallen to eight on that scale. All the cocks being closed, ignite the platina wire. The explosion will be known to take place, both by the flash and sharp noise which it produces. As soon as these indications are perceived, the cock communicating with the gage may be re-opened. Nearly three volumes of the mixture will be found to have disappeared, and by the time that the thermometer indicates the temperature to be in statu quo, it will be found that the deficit arising from the combustion will a little exceed that quantity.

In analysing gaseous compounds of carbon with hydrogen, this apparatus may be advantageously employed; due proportions of the carburet and of oxygen gas being previously mingled in an appropriate vessel over water. Suppose, for instance, olefiant gas were in question; one volume of it being mixed with four of oxygen: after the explosion two volumes will be found wanting; because, in one volume of the carburet, there are two of hydrogen and two of carbon vapor. Each volume of the latter, will unite with one of oxygen, without altering its volume. The two volumes of hydrogen will take one of oxygen, and be condensed with it into water. Of

* The necessary mixtures are effected either by means of the volumeters or the sliding rod gas measure, of which I published engravings and descriptions in this Journal, vol. 12, page 36, 1827; and in the London Philosophical Magazine for 1828, vol. 32, page 126.

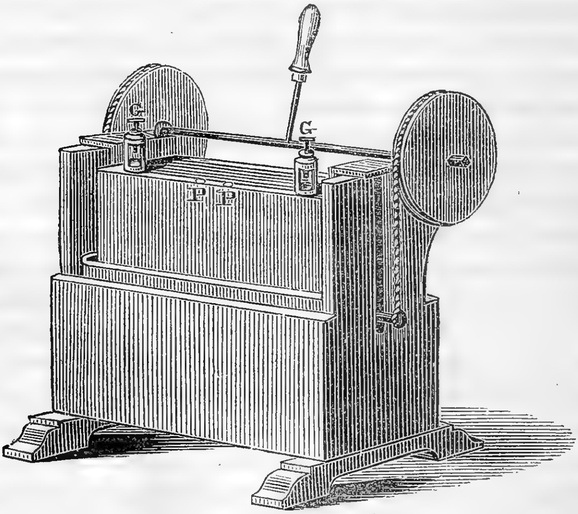
course, in lieu of the five volumes introduced, two volumes of carbonic acid, and one residual volume of oxygen will remain.

By means of a forcing air pump, of which a description will be given in the next number of this Journal, the gas may be transferred to a receiver, and washed with ammonia, or milk of lime, and then allowed again to enter the iron bottle. Meanwhile, by due attention to the gage, the quantity which has been absorbed may be ascertained; and consequently, the proportion of carbonic acid resulting from the oxidizement of all the carbon in the gas subjected to analysis.

Instead of employing the forcing air pump, by substituting a large valve cock for the screw by means of which an aperture in the bottle at A is closed, mercury may be introduced through a funnel, and, by its pressure, the residual gas may be easily conveyed, by a flexible leaden tube, to a receiver over the mercurial reservoir, and analyzed in the usual way. For this purpose it is necessary that the valve cocks with which the mercury comes in contact, should be of iron or steel; and, accordingly, I employ such where mercury is to be used.

The gases may be supplied, without previous measurement and admixture, by receiving them into the bottle from their respective reservoirs, and measuring them as they enter, by means of the gage.*

* I subjoin an engraving of the colorimotor, by means of which the ignition of the platina wire, and consequent inflammation of the gaseous mixtures are accomplished.



This engraving will convey an idea of the calorimotor suitable to effect the ignition of the platina wire in the galvano ignition apparatus above described. It

When hydrogen is employed to analyze the air, with the exception of the quantity requisite to adjust the gage as already explained, it should be the last admitted; since otherwise it is liable, from its lightness, to pre-occupy the cavity in which the platina wire is situated; so that some time would be required for its sufficient admixture with atmospheric oxygen to constitute a combustible mixture.

In this mode of operating, when the apparatus is once well arranged, the analysis of the air may be repeated as often as desired, and after any interval of time.

Art. VII.—*Engraving and Description of Voltaic Series, combining the advantages of the trough of Cruickshank with those of the Deflagrator;* by Prof. R. Hare, M. D., &c. &c.

TO THE EDITOR.

Dear Sir—In your last number, an abstract was made from Faraday's researches, agreeably to which my deflagrator, is represented as the best construction, of the voltaic series. It will be recollected, that one principal ground of this alleged superiority is the mechanism by which the acid is thrown on or off of the plates, by a partial revolution of the troughs, containing the series and acid, to the extent of one fourth of a circle.

Subsequently this mechanism, which may be designated as the *quadri-rotary mechanism*, was applied by me to troughs constructed upon the principle of that of Cruickshank, the pairs being made to exist in a greater degree of proximity than had been previously attempted. It is well known that the Cruickshank pair consists of a plate of zinc and a plate of copper, corresponding in size and shape, placed face to face, and soldered together at one or more of their edges. Pairs of this kind, slipped into grooves, in a trough so as to be parallel, formed the Cruickshank trough which took place of the

---

should contain two galvanic pairs, each consisting of two plates of zinc, 10 × 12, alternating with three of copper. The copper plates of one pair, and the zinc of the other being soldered to a common metallic strip, the other plates of zinc being soldered to one strip, the copper to another, each of the last mentioned strips is furnished with a gallows screw G G. Between these screws and those at W W, (see figure in the text,) a communication is made by leaden or copper rods.

To complete the circuit, it is only necessary, to depress the handle attached to the pulleys, in order to raise the reservoir of diluted sulphuric acid, and thus to cause it to act on the plates.

couronne des tasses, or *pile* of Volta. The Cruickshank troughs were superseded by Babbington's apparatus, having cells made in troughs of porcelain, or in mahogany troughs with glass partitions, the plates being attached to a bar by which ten or twenty might be lifted at once from the acid, so as to suspend its reaction with the zinc. It is to this characteristic, that the preference given to the last mentioned construction by Davy and others has been ascribed. It occurred to me that the quadri-rotary mechanism, being applied to the Cruickshank trough, would completely obviate the difficulty of suspending the chemical reaction, which had led to the abandonment of this construction of the series, and likewise that the saving which had been alleged to follow from the surrounding of the zinc by copper, could be equally secured by the Cruickshank pairs. As in these the copper and zinc afford reciprocal support, the zinc might be of less than half the thickness requisite in isolated plates, and two of the former might be put in less space than one of the latter. In either case there would be the same surface subjected to oxidizement, since one of the surfaces of each zinc plate in the Cruickshank pairs is protected from the acid. It was ascertained that at least three Cruickshank pairs could be introduced within an inch, so that more surface could be exposed in a given space in this way, than in any other. Since that time a small trough has been constructed in which sixty pairs were introduced within ten inches and a half.

The advantages of this construction are as follows: the association of the two metals into one compound plate, renders them both firmer so as to admit of greater evenness of surface and more exact parallelism, and consequently of greater proximity without contact: the soldering being once made need not be disturbed in order to remove and clean the plates: the communication between the plates of zinc and copper is more ample and less liable to fail.

The method of making the grooves to which I resorted, is as follows; a plough plane must be so arranged as to have the distance between the cutting iron and guide plate equal to that required for the interstices between the plates. A wooden board is to be procured of about from three eighths of an inch to half an inch in thickness, according to the proposed size of the trough, and sufficiently wide, when slit, to form the bottom and sides of a box to contain the pairs. In this board the grooves are made by running the guide plate in one groove, while another groove is made by the cutting iron. Afterwards the board being slit, so as to make the sides and bottom of a box to receive the pairs, the grooves are easily made to correspond. The box being heated as hot as the wood will bear and soaked with melted suet or beeswax, the pairs are slid into the grooves.

To correspond with the outside of the box containing the pairs, the inside of one of two troughs placed side by side, as are those represented in the engraving, having been prepared, the box must be cemented therein by a mixture of one part of suet and seven of rosin. The wood should be heated as hot as possible without taking fire. This may be effected by shavings, by a chauffer of coals, by a flambeau made with spirit of wine, spirit of turpentine, or coal naphtha. By the consequent rarefaction, the pores being nearly vacated of the moisture and air with which they are naturally occupied, on cooling they will imbibe the cement which should be fused and introduced while the heat is at a maximum.

A box without grooves, otherwise similar to that made for the pairs, should be made for the other compartment. Both boxes should be heated on the outside and soaked with cement, and introduced into their places, while hot enough to keep the cement fluid. In troughs thus constructed I have not found the leakage, of which Mr. Faraday complains, to take place. In fact I have made troughs without an inside box, which are made tight simply by tongueing the boards, &c. putting them together with screws and white lead, and then cementing them on the inside as above described.*

I propose in future to have the plates of an oblique form upon one of their sides, so as to be of a lesser width at bottom than at the upper edge. By these means they may easily be slid into their grooves, or removed for cleansing. The use of a membrane, as in Daniel's ingenious apparatus, to prevent deposition on the plates, may be found advantageous, where a permanent supply of voltaic electricity is desirable, and is hypothetically highly interesting, as verifying some of those anticipations arising from Faraday's researches, which led to its construction; but yet I hold that expedient to be inapplicable, in those constructions of voltaic series, which are otherwise most convenient, efficient and compact.

Of the apparatus which I have latterly used, and which I call the Cruickshank deflagrator, I send engravings and descriptions, in some

---

* The common wood screw is not sufficient. I used screw bolts and nuts, the latter let into the wood. In bringing up the joints a powerful joiner's clamp press was employed.

printed pages, abstracted from the Transactions of our American Philosophical Society, Vol. V, Part 3, lately published.

Galvanic Deflagrator of one hundred pairs, of fourteen inches by eight.

Fig. 1.

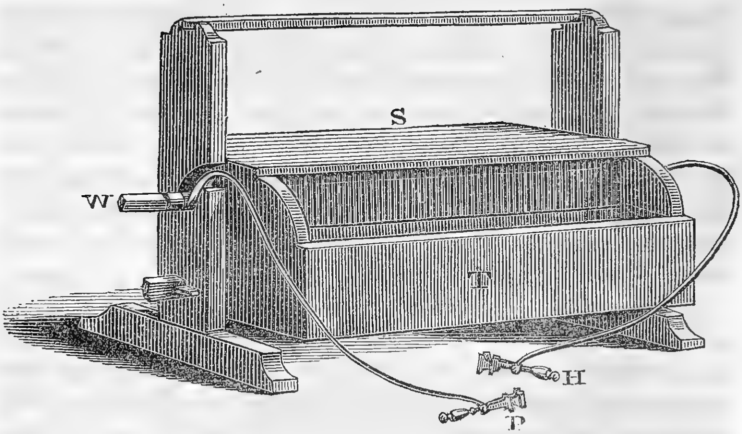


Fig. 1 represents a voltaic series, upon the plan of the trough of Cruickshank, associated with another trough destitute of plates, and of a capacity sufficient to hold all the acid necessary for an ample charge. The trough containing the series is joined to the other lengthwise, edge to edge, so that when the sides of the one are vertical, those of the other must be horizontal. The advantage of this arrangement is, that by a partial revolution of the two troughs, thus united, upon pivots which support them at the ends, any fluid which may be in one trough must flow into the other; and, reversing the movement, must flow back again. The galvanic series being placed in one of the troughs, the acid in the other, by a movement such as above described, the plates may all be instantaneously subjected to the acid, or relieved from it. The pivots are made of iron, coated with brass or copper, as less liable to oxidizement. A metallic communication is made between the coating of the pivots, and the galvanic series within. In order to produce a connexion between one recipient of this description and another, it is only necessary to allow a pivot of each trough to revolve on one of the two ends of a strap of sheet copper. To connect with the termination of the series, the leaden rods, to which are soldered the vices, or spring forceps, for holding the substances to be exposed to the deflagrating power, one

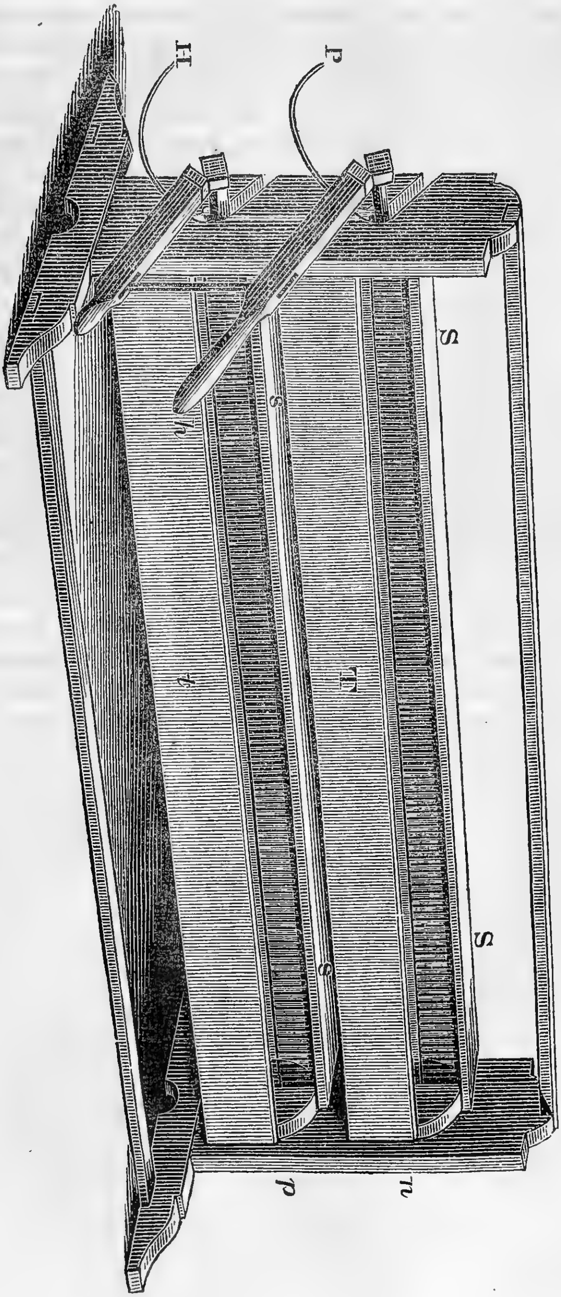


Fig. 2.

Galvanic Deflagrator of seven hundred pairs, of seven inches by three.

end of each of the lead rods is soldered to a piece of sheet copper. The pieces of copper, thus soldered to the lead rods, are then to be placed under the pivots, which are of course to be connected with the termination of the series. The last mentioned connexion is conveniently made by means of straps of copper, severally soldered to the pivots and the poles of the series, and screwed together by a hand-vice. Each pair consists of a copper and a zinc plate, united by solder at the upper edge, where the copper is made to embrace the edge of the zinc. The three remaining edges are made to enter grooves in the wood, being secured therein by cement. For each inch in the length of the trough there are three pairs. In the series represented by fig. 1, there are one hundred pairs of fourteen inches by eight; in that represented by fig. 2, there are seven hundred pairs of seven inches by three. The latter will deflagrate wires too large to be ignited by the other, but is less powerful in producing a jet of flame between the charcoal points, or in giving a shock.

Fig. 2, on the opposite page, represents a series which comprises two Cruickshank deflagrators, so constructed as to co-operate in one circuit by an adequate communication between their poles, and being so associated with a lever, as to be made, by means of it, to revolve simultaneously. They may be made to act either collaterally, as a series of 350 pairs, or consecutively, as 700. As the plates are seven inches by three, when used collaterally, they are equivalent to 350 plates of seven inches by six.

*Combustion of Phosphorus in nitrous oxide gas.**

There is a striking backwardness in the oxides of nitrogen to part with their oxygen to phosphorus, until it be intensely ignited, either by an incandescent iron, or by the access of uncombined oxygen.

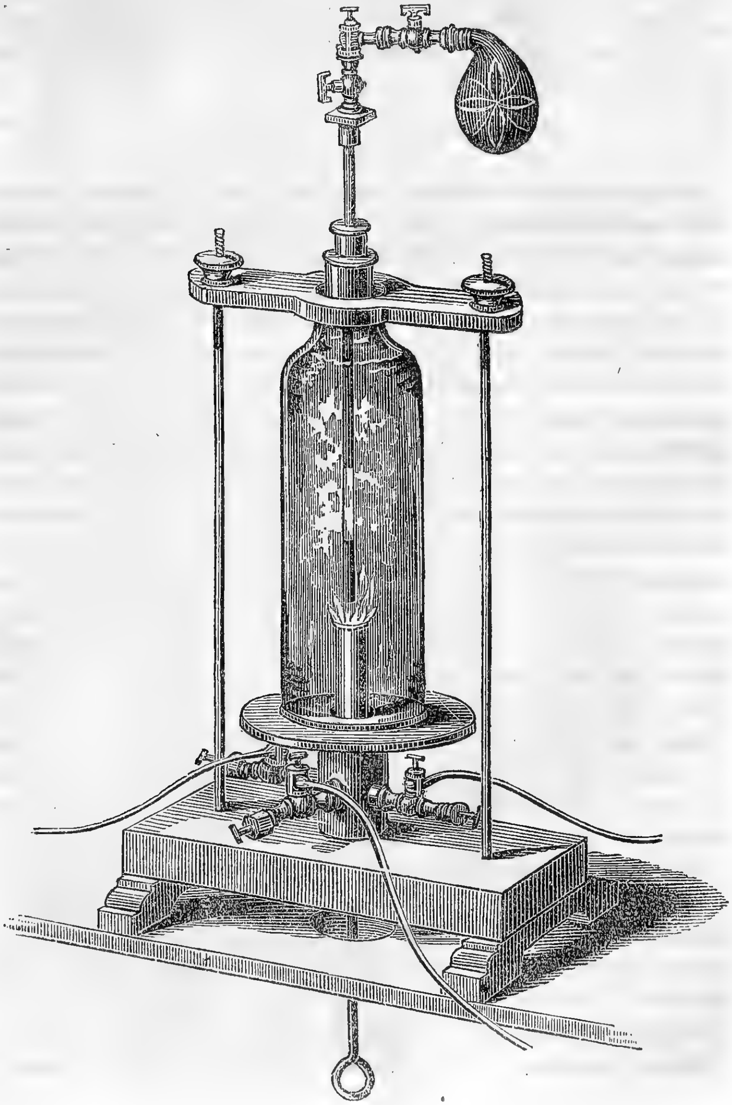
This characteristic in the case of nitrous oxide, may be illustrated by means of an apparatus like that employed for the combustion of phosphorus in oxygen with a tall cylindrical receiver, and a tube descending through the neck, and along the axis of the receiver, terminating in a capillary orifice over the cup for holding the phosphorus. The upper end of the tube, outside the receiver, is furnished with a cock, to which a gum-elastic bag inflated with oxygen is attached.

Under these circumstances, the receiver having been exhausted, and filled with nitrous oxide; phosphorus, previously placed within the cup, may be melted without taking fire. But as soon as the cock

* An apparatus employed by Dr. Hare for exhibiting the same peculiarity in the case of nitric oxide has already been published in this Journal.

communicating with the bag of oxygen is opened, an intense combustion ensues; since the oxygen, emitted in a jet from the capillary orifices of the tube, reaching the melted phosphorus excites it into an active combustion, which the nitrous oxide afterwards sustains with great energy.

Combustion of Phosphorus in Nitrous Oxide illustrated.



ART. VIII.—*A Natural System of Botany; or a systematic view of the Organization, Natural Affinities, and Geographical Distribution of the whole Vegetable Kingdom; together with the uses of the most important species in Medicine, the Arts, and rural or domestic economy;* by JOHN LINDLEY, Ph. D. &c. *Second edition, with numerous additions and corrections, and a complete list of genera, with their synonyms.* London: Longman, Rees, &c. 1836. pp. 526. 8vo.

(Communicated for this Journal.)

THE cultivators of Botany in this country are generally acquainted with the former edition of this work through the American reprint, edited by Dr. Torrey, and published by the Messrs. Carvill of New York, in the spring of 1831. Dr. Lindley's treatise was at the time of its appearance, the only introduction to the Natural System in the English language, if we except a translation of Achille Richard's *Nouveaux Elemens de la Botanique*, which was published about the same period. It is unnecessary to state that a treatise of this kind was greatly needed, or to allude either to the peculiar qualifications of the learned and industrious author for the accomplishment of the task, or the high estimation in which the work is held in Europe. But we may very properly offer our testimony respecting the great and highly favorable influence which it has exerted upon the progress of botanical science in the United States. Great as the merits of the work undoubtedly are, we must nevertheless be excused from adopting the terms of extravagant and somewhat equivocal eulogy employed by a popular author, who gravely informs his readers that no book, since printed bibles were first sold in Paris by Dr. Faustus, ever excited so much surprise and wonder as did Dr. Torrey's edition of Lindley's Introduction to the Natural System of Botany. Now we can hardly believe that either the author or American editor, of the work referred to, were ever in danger, as was honest Dr. Faustus, of being burned for witchcraft; neither do we find any thing in its pages calculated to produce such astonishing effects, except, perhaps, upon the minds of those botanists, if such they may be called, who had never dreamed of any important changes in the science since the appearance of the good Dr. Turton's translation of the Species Plantarum, and who speak of

Jussieu as a writer who "has greatly improved upon the natural orders of Linnæus."* We have no hesitation, however, in expressing our conviction that no single work has had such a general and favorable influence upon the advancement of botanical science in this country, as the American edition of Dr. Lindley's Introduction to the Natural System. This treatise, however useful, was indeed not absolutely indispensable to the favored few, who, aided by the works of Jussieu, Brown, De Candolle, the elder and younger Richard, &c. were already successfully and honorably pursuing their investigations; but to the numerous cultivators of botany throughout the country, who could seldom be expected to possess, or have access to, well furnished libraries, and to whom the writings of these great luminaries of the science were mostly unknown except by name, this publication was a truly welcome acquisition, conferring advantages which those alone who have pursued their studies under such unfavorable circumstances can fully appreciate.

A second and greatly improved edition of this work having appeared within the past year, it occurred to the writer of these remarks, that a cursory notice of it might not be unacceptable to the readers of the American Journal of Science. We do not intend, in these observations, to engage in a defense of what is called the Natural System of Botany; but take it for granted, that the science can by no other method be successfully and philosophically pursued: or,

---

* Dr. Lindley is quite right in his remark that the chief difficulties the student has to encounter in the study of botany, upon the principles of the Natural System, have been very much exaggerated by persons who have written upon the subject without understanding it. To refer to a single instance. In the fifth edition of the Manual of Botany, by Mr. Eaton, an account of the Natural Orders of Jussieu is given, in which the genera Ambrosia and Xanthium are referred to Urticeæ; and in a note it is added, "*Some botanists place the last two genera in the order Corymbiferæ, also in the Linnæan class Syngenesia. I see no good reason for these innovations.*" Now Linnæus, in his artificial arrangement, certainly did place these genera (and also Parthenium and Iva,) in Monœcia Pentandria; but the *innovator* in this instance, is Jussieu himself, who never referred these two genera to Urticeæ, but places them in his order *Corymbiferæ,* (Compositæ,) where they truly belong. The descriptions of Natural Orders in Eaton's Manual, purporting to be taken from Jussieu, bear a very remote resemblance indeed to the ordinal characters of the admirable *Genera Plantarum* of that author, while the occasional criticisms on its supposed errors afford the clearest proof that the work was not understood by the author alluded to. It should be recollected that, previously to the reprint of Dr. Lindley's Introduction, Mr. Eaton's Manual was the only work professing to give a view of the Natural System, within the reach of the great majority of the botanical students of this country, excepting, perhaps, the American edition of Smith's *Grammar of Botany.*

to employ the forcible language of Linnæus, "*Methodus naturalis primus et ultimus finis botanices est et erit,*"......"*Primum et ultimum in hoc botanicis desideratum est.*" The few persons who remain at this day unconvinced of its advantages are not likely to be affected by any arguments that we could adduce. A somewhat larger number may perhaps be found in this country who admit the importance and the utility of a natural arrangement in the abstract; but decline to avail themselves of the advantages it affords in the study of plants, because, forsooth, it is too much trouble to acquire the enlarged views of vegetable structure which are necessary for the application of its principles. It would almost seem, from the views and practice of such botanists, that they considered it the chief object of a classification to afford the means of ascertaining the name of an unknown plant by the slightest examination of its structure, and with the least possible expenditure of thought.

In the first edition, Dr. Lindley entered into some detailed explanations to show the fallacy of the common opinion that the artificial system of Linnæus is easy, and the Natural System difficult of application. The sentiments of the public having undergone so great a change upon this subject within the last five or six years, that he finds it no longer necessary to adduce these considerations, and accordingly commences at once with a developement of the principles on which the Natural System is founded, viz. "That the affinities of plants may be determined by a consideration of all the points of resemblance between their various parts, properties, and qualities; that thence an arrangement may be deduced in which those species will be placed next each other which have the greatest degree of relationship; and that consequently the quality or structure of an imperfectly known plant may be determined by those of another which is well known. Hence arises its superiority over arbitrary or artificial systems, such as that of Linnæus, in which there is no combination of ideas, but which are mere collections of isolated facts, not having any distinct relation to each other."—(*Preface, p.* vii.)

We have never met with a more clear and succinct account of the principles on which the primary divisions of the vegetable kingdom rest, than that comprised in the following extract. Those acquainted with the first edition will perceive that the author has changed his opinions respecting the number of these primary divisions, or classes; the *Gymnospermæ*, or Flowering plants with naked ovules (comprising the Coniferæ, Cycadeæ, and, according to Brongniart and Lindley, the Equisetaceæ,) and the *Rhizanthæ*, as originally established by Blume, being here admitted to the rank of independent classes. Their claim to this rank, however, can as yet be hardly considered as fully established.

"One of the first things that strikes an enquirer into the structure of plants, is the singular fact, that while all species are capable of propagating their race, the mode in which this important function is accomplished is essentially different in different cases. The great mass of plants produce flowers which are succeeded by fruits, containing seed, which is shed or scattered abroad, and grows into new individuals. But in Ferns, Mosses, Mushrooms, and the like, neither flowers, nor seeds properly so called, can be detected; but propagation is effected by the dispersion of grains or spores which are usually generated in the substance of the plant, and seem to have little analogy with true seeds. Hence the vegetable world separates into two distinct groups, the *Flowering* and the *Flowerless*. Upon examining more closely into the respective peculiarities of these two groups, it is found that flowering plants have sexes, while flowerless plants have none; hence the former are called *Sexual*, and the latter *Asexual*. Then again the former usually possess a highly developed system of spiral or other vessels, while the latter are either altogether destitute of them, or have them only in the highest orders, and then in a peculiar state: for this reason flowering plants are also called *Vascular*, and flowerless *Cellular*. More than this, all flowering plants, when they form stems, increase by an extension of their ends and a distention or enlargement of their sides; but flowerless plants appear to form their stems simply by the addition of new matter to their points; for this reason while the former are principally *Exogens* or *Endogens*, the latter are called *Acrogens*. Flowering plants are also for the most part furnished with respiratory organs or stomates, while flowerless plants are to a great extent destitute of them. No one then can doubt that in the vegetable kingdom, two most essentially distinct divisions exist, the *Flowering* and the *Flowerless*, and that these differ not in one circumstance only, but are most essentially unlike in many points both of organization and physiology.

"In like manner, *Flowering plants* are themselves divisible into equally well marked groups. Some of them grow by the addition of new woody matter to the outside of their stem beneath the bark; these are *Exogens*: others grow by the addition of new woody matter to the inside of their stem near the centre; those are *Endogens.* But Exogens have two or more cotyledons to their embryo, and hence are called *Dicotyledons;* while Endogens have only one cotyledon, and are, therefore, *Monocotyledons.* Exogens have the young external wood connected with the centre by medullary processes; Endogens having no occasion for such a provision, are destitute of it. In Exogens the leaves have their veins disposed in a netted manner; in Endogens the veins run parallel with each other. The number of parts in the flower of an Exogen is usually five, or its multiples; in an Endogen it is as usually three, or its multiples. In germination the young root of Exogens is a mere extension of the radicle; but of Endogens it is protruded from within the radicle; hence the former have been named *Exorhizæ,* and the latter *Endorhizæ.* In this case then, as in the last, we have two groups differing entirely from each other in their germination, the structure of their stem and leaves, their mode of growth, the arrangement of the parts of the flower, and in the organization of their embryo. It is impossible, therefore, not to recognize such groups also as natural.

"To this separation of the vegetable kingdom into Exogens, Endogens, and Acrogens, or by whatever synonymous names these groups may be known, many botanists confine themselves. But there are two others, of subordinate importance perhaps, but nevertheless characterized by circumstances of a similar nature, and, therefore, I think, to be esteemed of equal dignity with them. In true Exogens and Endogens, the fertilizing principle is communicated to the young seeds through the medium of a stigma which terminates a case or pericarp in which they are enclosed. But in some plants otherwise Exogens, the fertilizing principle of the pollen is applied immediately to the seeds, without the intervention of any pericarpial apparatus, and they bear the same relation to other Exogens as frogs and similar reptiles to other animals. These plants, therefore, are separated as a distinct class, under the name of *Gymnosperms.* Like the other groups of the same grade, these are also found to possess peculiarities of a subordinate nature. For instance, they have in many cases more cotyledons than two, whence they have been called *Polycotyledons;* their radicle usually adheres to the albumen in which the embryo lies, and that circumstance has given rise to the name *Synorhizæ.* The veins of their leaves, when they have any veins, are either simple or forked; in which respect they approach Endogens on the one hand, and Acrogens on the other.

And finally, their vascular system is very imperfect compared with that of other Exogens of an equal degree of development.

The other group, called *Rhizanthæ*, is far less correctly known, but it seems to stand as it were between Endogens and Acrogens of the lowest grade; agreeing with the latter in the absence or very imperfect state of the vascular system, in a general resemblance to Fungi, and in the apparent seeds being mere masses of sporules; but apparently according with Endogens in the ternary number of their floral envelopes, and in the presence of fully developed sexes.

"Certainly there is no possibility of obtaining such important primary groups as these by any kind of artificial contrivance."—(*Preface, p.* x.—xii.)

The grand natural divisions of the vegetable kingdom are, therefore perfectly obvious, and may be very clearly defined. With our present knowledge of vegetable structure no great difficulty is experienced in characterizing the orders or natural families, and all subordinate groups. The great desideratum has ever been to effect such an arrangement of the orders under the primary classes, that each family should be placed next to those which it most nearly resembles. This might easily be accomplished, if the idea once so strongly insisted upon by poets and metaphysicians, of a chain of beings, a regular gradation, by a single series, from the most perfect and complicated to the most simple forms of existence, had any foundation in truth. On the contrary, nothing is more evident, than that almost every order, or other group, is allied not merely to one or two, but often to several others, which are sometimes widely separate from each other; and, indeed, these several points of resemblance or affinity, are occasionally of about equal importance. A truly natural lineal arrangement is therefore impracticable, since by it only one or two out of several points of agreement can be indicated. As this method is, however, the only one that can be followed in books, all that can be done is to arrange the orders in such a manner as to offer the least possible interruption to their natural affinities. The number of orders is so large that practical convenience seems to require their arrangement into groups subordinate to the primary classes; and when manifestly natural assemblages cannot be recognized, we are obliged to employ those which, being less strongly marked, and distinguished by a smaller number of characters, are apparently of a more artificial nature. The arrangement employed by the learned Jussieu, in his celebrated *Genera Planta-*

rum, although to a considerable extent artificial, has been almost universally adopted, until within the last few years.

In this method Dicotyledonous plants are primarily divided into three groups; the first including those with a polypetalous corolla; the second, those with a monopetalous corolla; and the third, those destitute of a corolla. These sections are subdivided, (as also the monocotyledons) by means of characters taken from the insertion of the stamens (or corolla,) whether hypogynous, perigynous, or epigynous. The arrangement here pursued, which is too well known to require further notice, is substantially adopted by De Candolle, the difference being more in appearance than reality. Dr. Lindley discarded these subdivisions in the first edition of his work; but the new distribution of the orders therein proposed possesses few advantages, and, indeed appears not to have satisfied the author himself. In the same year with the publication of the work just mentioned, the *Ordines Plantarum* of Bartling appeared, in which a more natural arrangement of the orders is attempted by the formation of aggregate or compound orders, as originally proposed, and in several instances successfully accomplished, by Robert Brown. An analogous plan was pursued by Agardh in his *Aphorismi Botanici,* (1817,) and again in his *Classes Plantarum,* (1825;) but these attempts, however ingenious, do not seem to have obviated, in any considerable degree, the inconveniences of a lineal arrangement.

We now return to our author, whose views upon this subject have been materially modified since the original publication of his Introduction to the Natural System. The method now employed was first sketched in the *Nixus Plantarum,* (1832,) and afterwards in the *Key to Structural, Physiological, and Systematic Botany,** (1835,) and is more fully developed and illustrated in the work before us. He now admits, as we have already seen, five primary classes, two of which, however, are much smaller than the others and of subordinate importance, and may be considered as transition classes, viz. *Gymnospermæ,* which connect Exogens with the higher Acrogens, and *Rhizanthæ,* which form the transition from Endogens to Acrogens of the lowest grade. The great class *Exogenæ* (*Dicotyledones* of Jussieu,) is divided into three subclasses, viz.

---

* This excellent little work consists of an augmented edition of the author's *Outlines of the first principles of Botany,* with a revised translation of the *Nixus Plantarum.*

1. *Polypetalæ;* those with the floral envelopes consisting of both calyx and corolla, the latter composed of distinct petals.

2. *Monopetalæ;* those with the petals combined in a monopetalous corolla.

3. *Incompletæ;* those always destitute of a corolla, the calyx also often incomplete or absent.

Thus far this mode of subdivision is nearly the same with that of Jussieu; Dr. Lindley, however, neglecting altogether the characters afforded by the insertion of the stamens, divides the polypetalous orders into seven, and the monopetalæ and incompletæ each into five sections, or *groups*. As a specimen of this plan, we copy the names of the groups of the first subclass, with their synoptical characters.

1. *Albuminosæ.* Embryo very considerably shorter and smaller than the albumen.

2. *Epigynosæ.* Ovary inferior, usually having an epigynous disk.

3. *Parietosæ.* Placentation parietal.

4. *Calycosæ.* Calyx incompletely whorled; two of the sepals being exterior.

5. *Syncarposæ.* None of the characters of the other groups, and with the carpels compactly united.

6. *Gynobaseosæ.* Carpels not exceeding five, diverging at the base, arranged in a single row around an elevated axis or gynobase. Stamens usualy separate from the calyx.

7. *Apocarposæ.* None of the characters of the other groups, but with the carpels distinct, or separable by their faces, or solitary.

Next, every group is divided into smaller groups, each of which includes one, two, or several orders. These minor groups are called *Alliances*, and are distinguished by the termination *ales*. Thus, under the Albuminose group, we have

Alliance 1. *Ranales*, comprising the Ranunculaceæ, Papaveraceæ, (with its suborder, as Lindley, following Bernhardi, considers it, Fumarieæ,) Nymphæaceæ, (to which Hydropeltideæ is improperly joined,) and Nelumbiaceæ;

Alliance 2. *Anonales*, which comprehends the Nutmeg tribe, the Anonaceæ, Magnoliaceæ, &c.;

Alliance 3. *Umbellales*, including the Umbelliferous tribe, with the nearly allied Araliaceæ;

Alliance 4. *Grossales*, consisting chiefly of the Grossulaceæ or Currant tribe; and lastly

Alliance 5. *Pittosporales,* which strikes us as a singularly heterogeneous assemblage, bringing together into one group the Vitaceæ, Pittosporaceæ, Olacaceæ, Francoaceæ, and Sarraceniaceæ!

All the subclasses and groups, both of Exogens and Endogens, are subdivided in a similar manner; but we cannot here proceed further with our enumeration. It will be borne in mind that the chief object of an arrangement of this kind, is to facilitate the study of the natural orders, by dividing the extensive primary classes into sections of convenient size, and to dispose these groups, and the orders they comprise, as nearly in accordance with their respective affinities and relationships as a lineal arrangement will allow. It is impossible, in the present state of our knowledge, to say how far the views of our author will ultimately be approved. Every attempt of the kind must necessarily be very imperfect, so long as the structure of only a limited portion of the whole vegetable kingdom has been attentively and completely examined; and the author is well aware "that this part of the work will require many great changes and improvements before it can be considered at all established." Notwithstanding the objections to which it is liable in many particulars, we agree with the author in the opinion, "that even in its present state it will be found to be attended with numerous advantages, and that every step which may be taken in determining the limits of natural groups subordinate to the primary classes, must be a decided gain to the science. So rapid is the advance of our knowledge of the vegetable kingdom, and so numerous are the new types of structure that present themselves to the systematic botanist, that it is to be feared lest another chaos should be brought on by the masses of imperfectly grouped species with which the science will soon abound."

The names of natural orders, as first established, do not appear to have been framed in accordance with any uniform rule, as to derivation or mode of termination. They were sometimes intended to express some characteristic feature, (Ex. *Leguminosæ, Labiatæ, Cruciferæ, Umbelliferæ, Coniferæ,* &c.) but more commonly some genus was selected as the type of the family, which was designated either by the plural of the genus simply, (as *Myrti, Lilia, Irides, Euphorbiæ,*) or with a slight prolongation, (as *Orchideæ, Jasmineæ,* &c.) or with the termination still further modified, (as in *Cyperoideæ, Aroideæ, Boragineæ,* or *Ranunculaceæ, Rosaceæ, Cucurbitaceæ,* &c.) The derivation of the name of an order from some prominent genus is now the universal practice; and for the sake of uniformity, as well as to distinguish such names from those of genera in the plural number, the termination *aceæ* is given to orders, and that of *eæ* to suborders, &c. The advantages of uniformity in this respect are manifest, and Dr. Lindley therefore insists upon the adoption of the rule in all cases. In the *Key to Botany*, published the year previous to the appearance of the second edition of the present work, the termination in *aceæ* is employed, not only in names of orders formed from those of genera, but also in the few still in use which relate to some peculiarity in the habit of the family. Thus, instead of Cruciferæ, Umbelliferæ, Coniferæ, &c. we have *Cruciaceæ*, *Umbellaceæ*, and *Conaceæ*. These are, however, very properly abandoned in the work before us, in which the author inclines to give up the old and familiar names of these orders, and to substitute those formed in the customary manner from well known genera. *Brassicaceæ*, *Apiaceæ* and *Pinaceæ* may certainly be as good names as any other when we once get accustomed to them, but it seems hardly necessary to make any change in the case of names of this kind. Dr. Lindley, as we have already seen, gives to the names of Alliances the termination *ales*, and to the groups that of *osæ*. The chief advantage of this system is, that the name of any group at once indicates its rank and importance.

The value of this work is greatly increased by the complete list of genera, (so far as known at the time of its publication,) with the principal synonyms, appended to each order and properly arranged under their several sub-orders, sections, &c. This laborious and difficult task is upon the whole very faithfully executed. We observe, however, several errors, typographical and otherwise, which are not noticed in the appendix, and in a few instances the same genus is referred to two different orders. The whole catalogue will doubtless be rendered more perfectly accurate in a future edition.

The whole number of genera comprised in this enumeration, exclusive of synonyms, is 7840. Sprengel's *Systema Vegetabilium*, which was finished in 1827, contains (exclusive of the appendix) only 3593 genera, or not quite half the number now known; while the 12th edition of *Systema Naturæ* (the last of Linnæus himself) comprises 1228 genera, or only about a third more than are now known in a single family.

This great and rapid increase is perhaps chiefly owing to the discovery of new plants; but it is also attributable in a good degree to the more accurate knowledge of those already known. In either case, it is the natural result of the progress of discovery; and instead of embarrassing the student, as is often supposed, does in reality render the study of the science much more clear and satisfactory.* Notwithstanding the great increase of genera within the last few years, it may be safely said that at no previous period could a really useful knowledge of the vegetable kingdom be acquired with so little labor. In hazarding this remark, it is of course taken for granted that the student will avail himself of all the advantages of modern physiological botany and of the natural system: for so rapid has been the discovery of new and strange forms of structure, for which the artificial arrangement of Linnæus makes no provision, that the student who takes that system as his guide has indeed a hopeless task before him.

The essential characters of the orders appear to have been very carefully revised in this edition, as also the remarks upon their affinities, geographical distribution and sensible properties. Did our limits allow, we might call the attention of our readers more particularly to this part of the work. We cannot bring our remarks to a close, however, without suggesting what we consider a very desirable improvement upon the manner in which the seed is described not only in this, but in almost all modern systematic works. It is very necessary that an organ which affords such important characters, both as to its situation in the fruit, and particularly as to its internal structure, should be described with the greatest possible clearness and precision, and in an uniform manner. The prevalent fault of which we complain is thus noticed, as long ago as the year 1811, by that most acute botanist, the late L. C. Richard.

---

* This remark rests upon the supposition that proposed genera are clearly distinguished from their allies by essential differences of structure, and are not such genera as those often proposed by Mr. Rafinesque, or Mr. Spach. (Vid. *Ann. Sci. Naturelles*, New Ser. *vol.* 4.) We cannot avoid here noticing a remark in Mr. Eaton's Manual of Botany, (ed. 7, p. 84,) intended as a severe criticism upon one of the most eminent botanists of the age. After giving, from De Candolle's Prodromus, the character of the genus *Enemion* (in which "antheris subrotundis" is translated "*with rough anthers*") the author subjoins—"*A doubtful genus; but De Candolle requires very little authority for a new genus.*" Now the genus Enemion was established by Rafinesque, upon what is now well known to be a species of *Isopyrum*; and De Candolle, who never saw the plant of Rafinesque, but merely copies his published description, prefixes the mark of a doubtful genus, and remarks that it seems to be the same as Isopyrum! The critic who could hazard such a remark must have presumed that the *Prodromus* of De Candolle was not likely to fall into the hands of his readers.

"Cæsalpinus, Adanson, Jussieu, and Gærtner, always take into view the direction of the embryo relative to the pericarp merely. This method appears to me improper; first, because it does not indicate with precision that direction which is most important to be understood; secondly, because the *pericarpic* direction of the embryo is often difficult to be ascertained, and is sometimes variable or even wholly different in the seeds of the same fruit. I have already shown by numerous examples in my *Analyse du fruit*, that the best method is to indicate the direction of the *seed* relative to the pericarp, and of the *embryo* relative to the seed."*

In very many descriptions, the direction of the embryo relative to the seed can only be inferred from the *pericarpic* direction, or which is still more objectionable, the same structure is described by very different language in different instances, thus rendering unnecessarily complicated an investigation which of itself is not usually difficult. We may adduce as an example the five orders comprised in the alliance *Ranales*, which stands at the commencement of Dr. Lindley's treatise. We have no means of ascertaining, from the essential character of any one of these orders, either the *spermic* direction and position of the embryo, or the situation of the chalaza and micropyle relative to the hilum, from which the former may be inferred. It is commonly stated that the embryo is situated at the base of the albumen; but it is not specified whether the radical is next the hilum, (as in Papaveraceæ, Nymphæaceæ, &c.) or points in the opposite direction, (as in Nelumbiaceæ and Cabombaceæ;) a matter of essential importance, since the seeds result in the one case from the ripening of *anatropous*, and in the other of *orthotropous*, ovules.

The students of botany in this country are greatly indebted to the learned editor and the enterprising publishers of the first American edition of this work. May we hope to have our obligations increased by the reprint of this greatly improved edition? A. G.

* Ann. Du Museum, vol. 17, p. 446.

Art. IX.—*Electro-Meteorological Observations;* by Jas. Swaim.

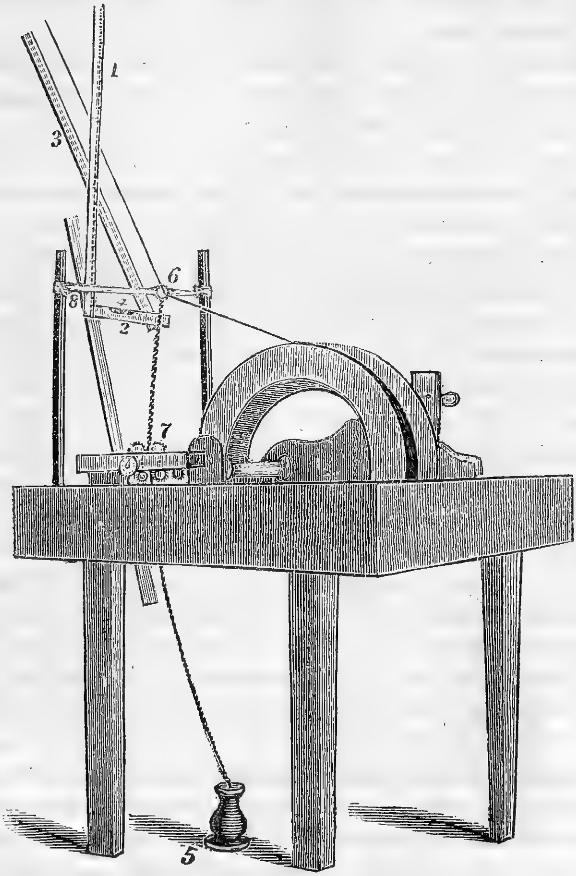
1836.	Dry thermometer.	Wet thermometer.	Dew point.	Barometer.	Perpendicular height of the kite when the leaves of the electrometer touch the side.	Length of wire out.	Wind.—Lower current.	Wind. Upper and middle current.	State of Weather, &c.
P. M. *h. m.*									
Oct. 23.	61.50	53.00	44.99	30.17			S. W.	W. by N.	Clear—clear.
" 24.—4	67.00	57.00	48.76	30.25	276	308	S. E.—S. W.	W. by N.	Clear—clear.
" 25.	43.50	36.00	22.05	30.29			N.	Clear.	Clear—clear.
" 26.—3 30	45.00	36.50	21.02	30.20	55	60	W.—N. W.	W.	Clear—cloudy.
" 27.	40.50	36.00	27.63	29.76			N. W.	W.	Cloudy—cloudy.
" 28.—4	46.00	39.00	27.52	30.05	44	52	S.—N. W.	Clear.	Clear—cloudy.
" 29.	51.50	42.50	29.69	29.93			N. W.	N. W.	Hazy—cloudy.
" 30.	42.50	38.50	31.80	29.22			N. by E.	W.	Light clouds—cloudy.
" 31.	40.50	35.00	24.32	29.34			E.	Clear.	Clear—cloudy.
Nov. 1.	48.00	43.00	36.03	29.14			N. N. E.	Clear.	Clear—clear.
" 2.				29.69			N. N. E.	N. N. E.	Cloudy—rain.
" 3.	45.50	40.50	32.79	29.84			N. W.	N. W.	Cloudy—clear.
" 4.—2 30	44.00	37.50	26.15	30.20	127	158	W.—N. W.	N. W.	Cloudy—clear.
" 5.—2 45	40.00	34.00	21.83	30.25	74	84	W.—N. W.	N. W.	Partially cloudy—cloudy.
" 6.	43.00	38.00	29.45	30.04			W. S. W.	Clear.	Cloudy day.
" 7.	51.00	43.50	33.25	30.09			S. W.	W. S. W.	Cloudy day.
" 8.	51.50	46.00	39.19	30.14			N. W.	Clear.	Cloudy—hazy.
" 9.—3 40	53.00	47.75	41.68	30.65	58	68	N. E.—E. N. E.	W. by N.	Clear—cloudy.
" " 3 50	52.25	48.00	43.13	30.65	82	112	N. E.—E. N. E.	W. by N.	
" " 4 7	53.50	49.00	44.04	30.65	151	266	N. E.—E. N. E.	W. by N.	
" 10.—2 35	54.50	50.25	45.79	30.57	476	700	E.	E. by S.	Clear, cloudy, rain at night.
" 11.	65.00	61.00	58.25	30.07			S. by E.	S. by W.	Cloudy—rain.
" 12.—3 25	62.25	58.50	55.65	30.05	136	200	W.—N. W.	S. W.	Clear day.
" 13.	50.00	44.00	35.96	30.02			N. N. W.	W. by S.	Clear day.
" 14.				29.80			E. N. E.	E. N. E.	Rainy day.
" 15.	46.00	42.20	36.75	29.90			N. by W.	S. by W.	Cloudy—clear.
" 16.	44.50	40.00	32.92	29.88			N. W.	W.	Cloudy—clear—rain.
" 17.	42.50	38.00	30.31	30.19			N. W.	N. W.	Clear—flying clouds.
" 18.	43.50	38.50	30.13	30.37			N. by W.	Clear.	Clear day.
" 19.	40.50	36.00	27.63	30.50			N. E.	W. S. W.	Clear day.
" 20.	51.50	48.50	45.13	30.21			N. E.	S. W.	Partially cloudy.
" 21.—3 10	58.50	55.00	51.95	29.95	415	564	N. W.—W.	W. S. W.	Rain—flying clouds.
" 22.—3 20	47.50	45.00	41.78	30.15	111	140	W.	Clear.	Clear—flying clouds.
" 23.—4 25	36.50			29.85	65	92	W.	W.	Clear—cloudy.
" 24.—2 45	41.00	38.50	34.32	29.08	134	148	W.—W. by S.	W. by N.	Clear—snow squalls.

The preceding experiments were made with common three stick kites two feet six inches long and two feet four inches wide, tapering from the middle to the top. Wire No. 30 was used, which was wound on a reel four feet in circumference, having a glass axle running on a frame about three feet high, which was made in the same manner as the one used by the Franklin Kite Club of Philadelphia.

An electrometer (5.) was connected with an iron ring (6.) through which the wire passed, and which was suspended by means of silk, in front of the reel for the purpose of preventing the wire from running off in winding up rapidly.

Also an instrument was used for finding the height of the kite, which I constructed in the following manner. Two stationary arms

(1. and 2.) of different lengths, were placed at right angles. The longer of these (1.) was graduated into small equi-distant divisions. A movable arm (3.) which was graduated in the same manner, was attached to the short arm, into which was let a bevel, (4.)



This instrument was attached to the front of the reel stand by means of a screw (8.) on which it could move.

As soon as the kite was sufficiently elevated to produce an expansion of the electrometer leaves, the instrument was adjusted until the small arm became level, and the movable arm was raised until it was parallel with the wire.

Then as the number of divisions on the movable arm was to the length of wire out, so the number of divisions on the stationary arm should be to the perpendicular height of the kite, or that portion of the lower surface of the positive electricity which was concentrated enough to expand the leaves of the electrometer. The bag or curve of the wire was so small that it was not calculated; a small allowance might probably be made when the length exceeded three hundred feet.

The length of wire out was determined by cog wheels, (7.) with a dial and hand to indicate the number of revolutions made by the reel, which cog wheels were placed on the end of the axle opposite to that on which the handle was placed. The height of the barometer and dew point was also taken at the moment when the expansion of the electrometer leaves took place. The dew point was found from the following formula discovered by Mr. Espy. Take two thermometers (Fahrenheit) that agree, or allow for the difference, cover one of the bulbs with a wet rag, and suspend them in the shade where there is a draft of air, or fan them briskly until they become stationary.

Then the difference of the thermometers being multiplied by one hundred and three, the product divided by the number of degrees indicated by the wet bulb and the quotient subtracted from the number of those indicated by the dry one, will give the dew point.

May not the aurora borealis and australis be produced by the approach of the positive electric fluid of the air to the surface of the earth?

At the poles these phenomena are frequent and brilliant; but as we approach the moist latitudes of the equator, they diminish in frequency and brilliancy, and appear only when the dew point is very low.

It therefore follows that it requires a very dry state of the atmosphere to permit their formation. The preceding experiments, as far as they go, strengthen the opinion of Franklin,* Hare† and others, that there exists, at all times, in the upper regions of the air, or in space beyond it, the electric fluid in an opposite state to that contained in the earth. They also tend to establish the doctrine that the positive electricity approaches the earth according to the dryness

* "Who knows then, but there may be, as the ancients thought, a region of this fire above our atmosphere, prevented by our air, and its own too great distance for attraction, from joining our earth."—*Franklin's letter to Cadwallader Colden, April 23d*, 1752.

† "I believe myself justified in the inferences, that not only the space occupied by the globe, but the region beyond our atmosphere, or where the air is sufficiently rare to act as a conductor, must abound with electricity."—*Prof. Hare's paper on Tornadoes, Aurora, &c.*

of the atmosphere, and approaches nearest to it when the dew point continues very low, and vice versa.

It is well known that when a body charged with positive electricity, approximates another negatively electrified, having a bad conductor between them, the positive electricity has a tendency to whiz off.* These facts being admitted it follows that when one body, (as the air,) being charged with positive electricity, approaches another, (as the earth,) negatively electrified, the positive electricity will whiz off and produce in the dark, those beautiful diffused and continued flashes known as the aurora borealis.†

The magnetic needle is deranged in proportion to the brightness of the aurora, which is another proof that the proximity of the positive electricity to the surface of the earth is the cause of the aurora borealis and australis.

If the higher strata of the air are at all times charged with the electric fluid in an opposite state to that of the earth there must exist a great excitement between them; for if a small glass tube be rubbed it will cause pieces of paper to stand on end. Now if so small a quantity of electric fluid will produce so great an excitement, what must be the effect of the immense body of electrified air on the living objects on the surface of the earth? May not animal and vegetable life depend upon that excitement, and if it does, would not an increase or diminution of that excitement as the fluid approached or receded from the surface of the earth, depress, or stimulate the vital action and cause disease? May not epidemics be produced in this way? The traveling of epidemics could be accounted for on this principle, for when one portion of the air happens to contain more or less of the fluid than the rest, it would be distributed to, or subtracted from the other portions until all were equally electrified, and thus carry the epidemic from one country to another.

Experiments of this nature would show whether at the time of an epidemic there was a difference in the height of the lower surface of the positive fluid, and what height was necessary to produce it. They would also show if comets, volcanic eruptions, &c. affect the electric state of the air.

---

* The electric brush, for example, produced from a point suspended above a conducting surface, is an aurora on a small scale; the rays of light are only seen above, where the fluid is given off.

† "The aurora may arise from discharges from one ocean of electricity to the other, which, not being concentrated by its attraction for intervening clouds within air sufficiently dense to act as an electric, assumes the diffuse form which characterizes that phenomenon."—*Prof. Hare's paper on the Water Spout, Aurora, &c.*

Art. X.—*Experiments upon the Induction of Metallic Coils;* by John B. Zabriskie, M. D. of Flatbush, L. I.

Prof. Henry of Nassau Hall, Princeton, made the important discovery, that if an electric current be passed through a long coil of wire or metallic ribbon, the electricity was much increased in intensity.* This effect of a coil, although at first it may appear merely as a very curious fact, yet is a discovery of great importance, especially in administering galvanism to animals, and in the construction of galvanic and electro-magnetic apparatus. The intervention of a coil converts a calorimotor into a deflagrator, giving it the power of burning metals, decomposing fluids, giving shocks to animals, &c.

In using galvanism for medical purposes, the coil is very convenient. It may be transported without any difficulty, and a simple galvanic arrangement consisting of a small plate of copper and zinc each, is sufficient to charge a large coil. The effect of the coil upon the system is different from that of an electrical machine or Leyden phial; it does not give a shock, but produces a spasm of the muscles, and if the circuit be repeatedly broken, or what is still more powerful, if this circuit be constantly reversed by means of the bascule of Ampere, a constant succession of spasms is felt, which, with a coil of any size becomes insupportable. On this account the coil is more especially indicated in rheumatism, palsy, and diseases of a similar nature, while the electricity of the Leyden jar is more powerful as a stimulant to produce absorption. But in the construction of galvanic apparatus, and in making electro-magnetic experiments, the coils of metallic ribbon are very valuable both in diminishing the expense of the instruments, and lessening the labor of the experiments, while the convenience of their application is much greater than that of a number of wires, allowing a ready alteration in the arrangement of the experiment, and of an easy mode of increasing the power of the apparatus merely by increasing the length of the coils.

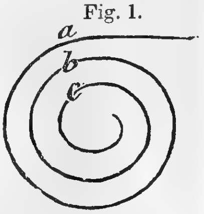
Galvanometers may be constructed upon this principle by surrounding the needle with a coil of metallic ribbon. An instrument constructed in this manner has been used by the author for a long time, and is found to be quite as sensible as the ordinary galvanoscope to small galvanic currents, and much more powerful when the current is large. It consists of a needle suspended upon a pivot, encompassed with a coil of zinc ribbon one half an inch wide and

* See the American Journal of Science, for July, 1832.

twelve feet long, covered with silk. The most delicate instruments are those constructed upon the principle described by Mr. Locke in the thirteenth volume of this Journal, in which a small wire is wound round a disk, so that the needle may be near the electrical current at every angle of deviation, and the needle is suspended by a silk thread. But all instruments of this size are galvanoscopes, merely indicating the presence of a small current, without giving us the power of comparing with each other the force of two currents, as exhibited in different experiments. For this purpose a large instrument constructed upon the plan mentioned above will be found very useful and correct. I have used a galvanometer composed of a needle two feet long, suspended upon a pivot, and surrounded by a coil of zinc ribbon covered with silk. This instrument will be found to be much more powerfully affected than those constructed with a coil of wire, and many very interesting and useful experiments may be made with it.

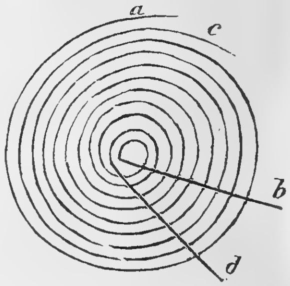
The effect of a coil of metallic ribbon has never been satisfactorily explained. Analogy would lead us to suppose that a current passing through a conductor in one direction would give rise to a current in an opposite direction, in an adjacent wire, from the known effects of electric and magnetic induction. But this appears not to be the fact, as two currents running in the same direction, increase the effect of each other, by being brought nearly together. Thus in the coil *a b c* (fig. 1.) the current passes in the same direction through the adjoining layers *a*, *b*, *c*, and the effect of the current in *a*, upon the current in *b*, instead of retarding its motion and diminishing its effect will be greatly to increase its intensity. And as every successive layer of the coil will produce the same effect, they all conspire to increase this intensity. That the effect of the coil is not entirely owing to induction of any kind, is proved by the experiment that a current from a calorimotor passed through a long wire or metallic ribbon, gives a spark, even when the greatest care is taken to prevent any portions of the conductor from lying near each other. This spark will not be as great as when the conductor is coiled in the form of a flat spiral, but the fact of its giving a spark, while a short conductor will not give any, shews that it is partly owing to the distance which the electric fluid is obliged to travel. The following experiment also shews that the

Fig. 1.



induction of galvanic currents must be extremely small. Two ribbons of zinc well covered with silk, each eighty feet long and one inch in width, were wound together into a flat spiral, and the two extremities of one were connected with a sensible galvanoscope. Upon connecting the ends of the other with a calorimotor, containing twenty four square feet of zinc, no effect could be perceived upon the galvanoscope, while a bright spark was perceived upon breaking the connection of the other coil with the calorimotor. This experiment shews that galvanic induction must be very trifling, if after a current traverses a conductor eighty feet long, it would produce no effect perceptible by a galvanoscope in another conductor of the same length, wound into the same coil. Let *a*, *b*, (fig. 2.) represent the extremities of one coil, and *c*, *d*, the extremities of another, both of which are coiled into one flat spiral. If the extremities, *a*, *b*, be connected with a sensible galvanoscope, upon connecting the extremities *c*, *d*, with a powerful calorimotor no effect will be perceptible by the galvanoscope. Again, upon connecting the inner end of one ribbon *b*, with the outer end of the other *c*, by means of a cup of mercury, and connecting the other extremities of both ribbons with a calorimotor, the fluid thus running the same way in both ribbons, a much more vivid spark is obtained by breaking the contact at the cup of mercury than when only one ribbon was used. If the outer ends of both ribbons be connected with the cup of mercury, upon passing the current through this coil which thus passes in opposite directions in the adjacent layers, no spark whatever will be perceived upon breaking the contact. These experiments therefore, appear to demonstrate, that adjacent currents running in the same direction, mutually conspire to increase the intensity of the effect, but when they run in opposite directions, they destroy it altogether. Part of the effect of a coil in increasing the intensity of the galvanic effect of a calorimotor, may be considered as owing to the length of the conductor, upon a principle not hitherto explained, and a part of its effect appears to be owing to the accumulation of the electric fluid in so small a space, whereby its repulsive power is increased, and it is enabled to overcome greater obstacles than in ordinary cases. The effect appears to be similar to that of a small

Fig. 2.



Leyden jar, which produces a more vivid spark and a sharper snap, than a large jar or a battery, in which the quantity of the fluid is increased, but its intensity diminished. The intensity of the galvanic fluid alone is increased by the coil, while its quantity remains the same, as is proved by the following experiment. A large galvanometer having a needle two feet long, was connected with a calorimotor of twenty four square feet of zinc, charged with a very weak acid. It gave a deflection to the needle of 35°. When the charge of this calorimotor with the same acid was passed through a coil of zinc ribbon two inches wide and one hundred and eighty feet long, the needle of the galvanometer still gave the same deviation of 35°. The spark at the same time was very vivid, and a shock was felt upon breaking the communication, when two handles soldered to the extremities of the coil were held in the hands. From this experiment we learn that the intensity of the electricity alone is increased by traversing a coil, and that the quantity of the fluid is not increased or diminished by passing through this circuit of one hundred and eighty feet.

The following experiments were made for the purpose of ascertaining the best method of constructing electro-dynamic magnets by means of coils of metallic ribbon.

1. A horse shoe of soft iron, twenty four inches long and one inch in diameter, was wound with a single covering of zinc ribbon covered with silk. When the extremities of the zinc were immersed in the cups of a small galvanic battery containing only eighteen square inches of zinc, a considerable degree of magnetism was induced in the iron.

2. A ribbon of zinc one inch in width and twenty four feet long, was wound around the same iron in small coils of four in thickness each, and succeeding each other the whole length of the iron. The effect in this experiment was greater than in the last, but not as great as I had reason to expect.

3. The same ribbon used in the last experiment was wound singly around the iron and then back again, covering the iron in this way with four thicknesses of the zinc, and winding in the same direction the whole time. Upon applying the battery, the induced magnetism was less than in the first experiment. As the ribbon was wound in the same direction the whole time, so the tangential direction of the revolving magnetic force in each layer of the zinc tended constantly towards the same pole of the temporary magnet—the result was unexpected. But it was doubtless owing to the oblique direction of

the covering, and which obliquity in the contiguous layers was in an opposite direction. As the ribbon was one inch in width and the iron one inch in diameter, the angle at which the layers crossed each other was more than 45°.

4. The whole horse shoe was then wound with the same ribbon singly, and that which was left after covering it was then coiled spirally upon one extremity of the iron. A strong magnetic action was now developed in the iron, much superior to that shown in any of the preceding experiments. The pole supporting the spiral coil was much superior in power to the other.

5. The iron horse shoe was then covered with one hundred and thirty feet of the same ribbon. This was wound singly over the whole iron, and a spiral coiled around each pole, the two spirals being coiled in different directions, and one containing about twenty five feet more than the other. This arrangement shewed considerable magnetic power, but not quite as much as the last. The two coils being wound in different directions, nearly neutralize each other, and the only power gained is that produced by the excess in the length of one coil over the other.

6. The same ribbon used in the last experiment, was coiled in two spirals, one around each pole of about equal size and wound in the same direction, and having the extremities of the ribbon in the center of each coil respectively. This produced the most powerful effect yet experienced, as the apparatus with the small battery of eighteen inches and very feebly charged was capable of raising fifty pounds.

7. The whole apparatus was disposed as in the last experiment, only that the extremities of the ribbon in one coil proceeded from the center, and in the other from the circumference. This produced the most powerful effect of all and with the same battery raised nearly twice the same weight.

8. If the whole apparatus be arranged as in the last experiment, and another coil be placed upon the extremities of the iron, taking care that the current run in the same direction in both coils, upon connecting this with the same battery as the other coil, the power of the magnet will be greatly increased.

It must appear evident to every one that the power of these magnets may be increased ad infinitum, by increasing the size of the horse shoe of soft iron, by increasing the width and length of the metallic ribbons, and also increasing the power of the battery. The effect may be considered as similar to that of a number of wires wound in the same direction, whose surface is equal to that of the ribbon. The labor of constructing a magnet of any size upon the old plan, by winding an iron with a number of wires, is very great, but a magnet constructed upon the plan mentioned above may be made in a few hours.

The expense of construction is also vastly diminished, and this, not only by diminishing the labor, but also the cost of materials. And as the power of the magnet may be increased to an unlimited extent, it must be preferable in every respect to those constructed with wires.

Art. XI.—*Description of the model of an Electro-Magnetic Engine, constructed by* John B. Zabriskie, M. D.

The facility with which the poles of an electro-dynamic magnet may be changed by reversing the electric current passing around it, first suggested the construction of electro-magnetic engines. The first apparatus constructed upon this principle was made by Prof. Henry, who gave a vibratory motion to a magnet to which were attached two bent wires alternately dipping in two cups of mercury on each side.

Some time since I constructed a model of an engine upon this principle, of which the following is a description.

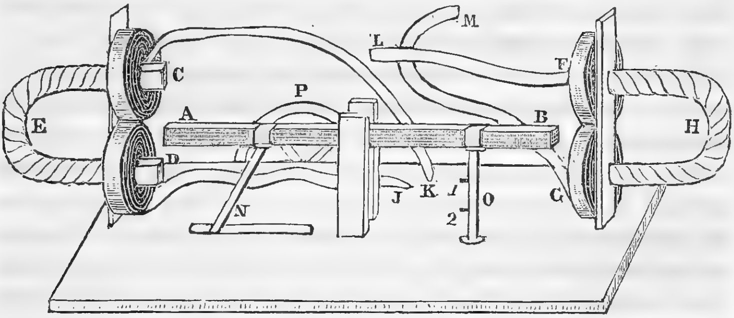
A, B, is a large compound magnet, composed of sixteen bars of steel, each one quarter of an inch in thickness and two feet long, magnetized separately, and combined into one magnet. This has an alternating motion upon an axis between the poles of two horse shoe galvanic magnets, constructed upon the principle mentioned in the preceding article.

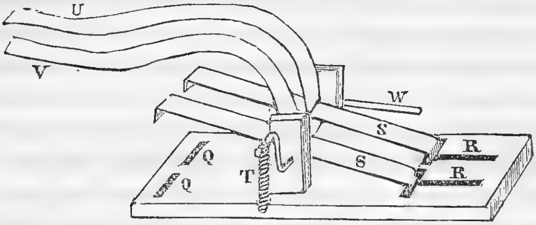
These magnets C E D, F H G, are composed each of a horse shoe of soft iron, twenty four inches long, and one inch in diameter, wound with a zinc ribbon one inch in width, and one hundred and twenty feet long.

N, is a rod turning a crank which moves the fly-wheel P. O, is a rod having two pins projecting from it which moves a lever attached to a bascule, which for the sake of distinctness is not represented in this figure but may be seen below. This is composed of a piece of mahogany pierced with four holes, two of which are oblong, and two shaped like a T. These holes are connected by pieces of copper, which form their bottom, being made into tight cups by sealing wax. These pieces of copper cross at the center, and are kept from touching each other by silk, and thus connect those holes which are diagonally opposite. S, S, are two pieces of copper which are fixed upon an axis in such a manner as to allow the extremities to dip alternately in the two pair of holes, which are filled with mercury. T, is a spring of wire, which by means of a crank fastened to the axis of the two strips of copper S, S, brings them down to the cups of mercury either way whenever the crank has passed the perpendicular. U, V, are two strips of zinc soldered to the center of S, S, and which are connected with the poles of a galvanic battery. W, is a lever fastened to the extremity of the axis, and which moves it together with the strips S, S. The extremities of the ribbons J, K, L, M, are inserted in the cups of mercury R, R, one from each magnet being inserted in each cup, and the arrangement being such that the upper poles of the temporary magnets shall both be of the same name. The lever W, is moved by the pins 1, 2, of the rod O, thus continually reversing the currents of electricity as they flow through the ribbons J K, L M, of the two galvanic magnets, and in this way changing the poles of these magnets.

Let us then suppose the end A of the magnet A B, to represent the north pole, and the pole C of the magnet C E D, also a north pole, while the arrangement is such that F is the north pole also of the magnet F H G. The ends J, K, L, M, being properly arranged in the two cups R, R, and the lever W, being placed between the pins 1, 2, of the rod O, upon connecting the zinc ribbons V, U, with the poles of a calorimotor the horse shoe magnets become instantly active, and the north pole A is repelled from the north pole C, while the south pole B is attracted towards the north pole F. The pin 2, by being raised, at length raises the lever W, and the strips S, S, are brought by the spring T to the cups Q, Q, when the currents in the zinc ribbons around the temporary magnets are instantly reversed, and the two lower poles converted into north poles. The north pole A is then instantly repelled from the north pole D, and the south pole B from the south pole F, until the pin 1 depresses the lever W, when the currents being again reversed the apparatus is in the same state as at the first. In this way a constant alternating motion is kept up. The model of this size works well, and with considerable power.

The power may be increased almost infinitely, by increasing the size of the temporary magnets, by increasing the number and the length of the bars of the permanent magnets, by increasing the width and length of the metallic ribbons surrounding the temporary magnets, and with these by increasing the power of the galvanic battery.





Art. XII.—*On Zinc Roofing;* by Prof. L. D. Gale, of the New York University.

Read before the Mechanics' Institute, June 6, 1837.

TO THE EDITOR.

Sir—The following remarks are intended as a reply to a paper by my friend Prof. Caswell, of Brown University, and which appeared in the 31st volume of this Journal. In March, 1836, I published in the Mechanics' Magazine of this city, (New York,) some remarks on zinc as a roofing material, substituted for slate, copper, tin or tiles, in which I stated the bad results that had followed the experiments made on zinc in this city, and pointed out the defects of that metal. Parts of that paper were copied into the newspapers of the day, from which I suppose Prof. C. obtained his idea of its correctness, inasmuch as he has both misconceived and misquoted my paper. In the present remarks I shall first state the positions taken in my former paper, and then proceed to give the details of my experiments, and let others who may be disposed to read the article draw their own conclusions.

Prof. Caswell commences the argument in his paper on the three following subjects, *supposed* to have been the divisions of my paper in the Mechanics' Magazine.

1. Difficulty of making the roof tight.
2. Deterioration of the water which falls from it.
3. Comparatively small resistance which it offers to the progress of fire.

My own division, however, is quite another thing: it is the following. Zinc is objectionable, (as a roofing,) First, from the great expansive power of the metal. Secondly, its brittleness. Thirdly, it deteriorates the water.

As Prof. C. has embraced my threefold division under two heads, namely, tightness of roofs and deterioration of the water, I shall make a few remarks on each of these. As his third division has no place in the original paper in question, it need absorb no time in this.

On the difficulty of making zinc roofs tight Prof. C. states, "There is no practical difficulty in making a zinc roof *perfectly tight*," and this is proved he says "by numerous certificates that place the subject beyond all reasonable doubt. A zinc roof may as easily be made tight as any other. There may be sheet zinc in the market of a bad quality, but none need be deceived on this point, since nothing is easier than to test its flexibility."

This is, it must be confessed, a pretty summary way of disposing of so important a matter. There is probably no place in the United States, where the experiment of zinc roofing has been so extensively tried as in this city. I think I can point out between seventy and one hundred buildings, to my personal knowledge, that have been covered with zinc, and in a very considerable portion of them it has been removed, and its place supplied by copper, tin, or slate; and those roofs that still remain, covered by zinc, I have ascertained by careful investigation, are more expensive to keep in repair than any other roofs whatever; and furthermore, I would say, that zinc is now almost entirely out of use in this city as a roofing material. Let me ask my friend Caswell, why most of our New York builders, as well as the proprietors of buildings, have abandoned the use of zinc, if there be *no practical difficulty* in making a zinc roof *perfectly tight?* Has Messrs. Crocker and Brother's zinc not come to the New York market? Has not "foreign zinc from the best manufactories" been imported and tried in this city? Yet all this avails nothing. So long as zinc retains the name and properties of zinc, it will continue to be a brittle metal, and though by heating it to a certain point, it may be rolled into thin flexible sheets, yet, after a few years, the metal becomes nearly as brittle as it was before being wrought. This fact is a prominent one, not confined to zinc only, but is common to most other metals; thus, malleable iron laid by for many years, becomes exceedingly brittle, from a tendency in the metal to assume the crystalline texture. I have observed fragments of sheet zinc laid by for a number of years, become so brittle that they would scarcely admit of bending without fracture. This seems to be a general principle, and I have little doubt that it forms one of the great difficulties in keeping zinc roofs in repair. Now if Prof. Caswell and Messrs. Crocker, Brother & Co. have discovered that there is no difficulty in making zinc roofs *perfectly tight*, and that their zinc "will bear to be doubled and hammered down without any appearance of fracture in the bend," and that the same remark is true of their zinc generally, I would advise them to come to New York and teach our builders how to make zinc roofs *tight;* for our workmen are unable to do it, and consequently zinc has almost entirely gone out of use for such purposes in this city.

I did observe in my paper, that water drained from a zinc roof is deteriorated, and thus is injured, either for washing or for culinary operations. Now because the same properties are not noticed by Thomson, Berzelius, Brande or Turner, Prof. Caswell has very judiciously come to the conclusion, that such properties as I have attributed to zinc cannot exist; therefore, I must have been mistaken. He also says I have not stated very fully the reasons on which my opinion was founded, with regard to the oxidation of zinc on roofs and the solubility of the oxide so formed, and as a proof that I was mistaken he has exposed water from a zinc roof to the air in clean glass vessels for several days, without any appearance of a precipitate: he has also kept the water for several days in a vessel of oxygen gas, subjected to frequent agitation, without precipitation or appearance of milkiness. Hence, he says, "if such water contains the suboxide of zinc, its presence is not to be detected in this way." The conclusion from the above experiment is, I think, very just, but we shall see whether it will apply equally to my experiments, which I shall now give in detail. They were made with a zinc roof, one hundred and eighty feet by ninety, equal to sixteen thousand two hundred square feet, and repeated for three months, at every shower of rain, and the effects produced by alternate dryness and moisture upon the metal were carefully noted. I cannot go into great minuteness of detail, but only sufficient to show the method of experimenting and the result.

As soon as a shower of rain began to fall on the roof, some of the first water that ran was collected and found to have a strong metallic taste, and to decompose soap. The water was set aside and allowed to remain at rest for some weeks, when a fine light yellowish sediment was found on the bottom. This effect was remarkably evident in the cistern, where the metal was precipitated from a large body of water. The sediment was carefully examined, and found to be oxide of zinc. In many cases no sediment was obtained from water that was examined, though collected in the early stages of a rain; so that no good results could be expected from a single experiment. The greatest amount of sediment was produced from a fall of snow, allowed to remain on the roof until removed by gradual thawing. The water drained from the roof under such circumstances was highly charged with metallic matter, which at length disappeared, and a sediment of oxide of zinc was found on the bottom of the vessel and the water left quite pure. Now as a metallic compound did exist in the water, and as that, at length, disappeared by exposure, and oxide of zinc was found deposited on the bottom of the vessel, I inferred that the soluble compound was a suboxide of zinc, and probably the one described by Berzelius. Since Prof. Caswell's paper has appeared, I have called on a number of builders and workers in metal, to ascertain whether and how far my experiments and opinion, expressed in my paper in the Mechanics' Magazine, coincided with facts as they occur to the workmen, and I am happy to say that I have nothing to retract. The following corroboratory remarks are from the Albany Daily Advertiser.

"Zinc.—The experience of two winters has proved to our satisfaction, that this is a worthless material for covering the roofs of houses. It very soon becomes rotten, and, as it is put on, affords very little protection against rain or snow. Tin or slate will be found far preferable."

In conclusion, I will again say, if zinc is a valuable material for roofs, which can easily be made tight, why is it that the article is going out of use as fast as possible? Why is it that no new zinc roofs are furnished in this great metropolis? It may be said, that they have used a bad article. But, I repeat, does not Crocker & Brother's zinc, does not the best foreign article, come to the New York market? Where have purchasers a better opportunity of selecting good zinc, where have builders a better opportunity of experimenting and ascertaining the best material for roofing? Is it probable that men who have gone deeply into the business of roofing with zinc, would readily abandon it, if they could sustain it? Would proprietors sustain the expense of tearing off the zinc and substituting some other material, if there were any other better method of managing? Would they not first resort to the expedient of mending? This last question I can answer from personal knowledge, that mending of zinc roofs has in some cases been nearly equal in expense to half the first cost. I am quite satisfied, that if my friend, Prof. Caswell, will review the whole matter of zinc roofs, he will come to the conclusion that notwithstanding the superior products of Messrs. Crocker, Brother & Co. there are still difficulties in the use of zinc as a roofing material that are not entirely imaginary.

ART. XIII.—*On the Common Blowpipe;** by J. W. BAILEY, Acting Prof. Chem. &c. U. S. Mil. Acad., West Point.

ON account of its portability, the facility of its use, and its numerous applications, the blowpipe ranks as one of the most valuable instruments of chemical research. It consists essentially of a tube, generally bent and having a small orifice, by means of which a current of air, from the lungs, may be forced through the flame of a lamp or candle.

Fig. 1.

Fig. 1, shows the simplest form of the blowpipe, and such ones are easily made from glass tube in case of necessity, but they are inconvenient when made of this material on account of their easy fusibility.

* These notes were drawn up to form part of the course of chemistry at West Point, and being solely intended as an *introduction* to the use of the blowpipe, were purposely made as elementary as possible—but it is supposed the directions may be useful to other students.—ED.

Even a piece of the stem of a tobacco pipe can be used as a blowpipe when no better means are at hand.

In experiments requiring a long continued blast, the moisture of the breath condenses in the tube in such quantities as to be inconvevient, and the best blowpipes are provided with a small chamber to collect this moisture, and prevent its being forced out at the orifice into the flame.

Fig. 2.

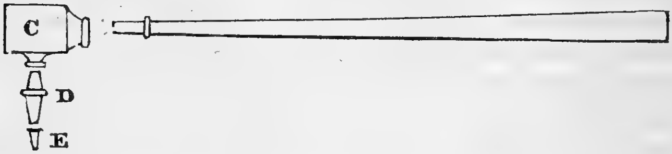


Fig. 2, shows the parts of a blowpipe provided with a chamber C. At D is a conical orifice which slips into the projection from the chamber. At E is a small perforated cone, to be placed *over* the end of D when a smaller orifice is required.

Fig. 3.

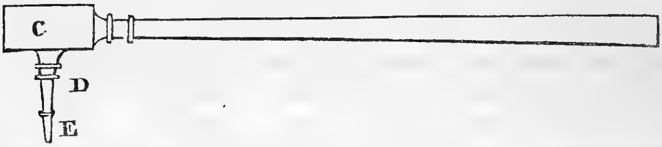


Fig. 3 shows the blowpipe arranged for use.

In using the blowpipe it is highly important to be able to keep up a well regulated and long continued blast. The power to do this can be acquired only by practice, but the following directions, taken from Shepard's Mineralogy, will facilitate the acquisition. "Closing the mouth, keep the cheeks distended with air, during a number of inspirations and expirations performed through the nostrils. Next attempt the same with the mouth-piece of the blowpipe between the lips: now as this provides an exit for the air in the mouth, the cheeks will soon collapse; to prevent this at the moment of expiration through the nose, a sufficient quantity of air must be allowed to enter the mouth to preserve their distention. By this means the air in the mouth is constantly subject to the same compression and flows in a uniform manner from the little orifice. Having acquired the habit of keeping up a continued current of air from the blowpipe, the beak is now brought within the border of the flame of a lamp or candle. We immediately perceive before the orifice a long and conical blue flame environed by an outer cone more resembling the common flame of a candle. It is at the apex of the blue cone that the most intense heat is produced."

"*Oxidation* takes place when we bring the matter of assay before the apex of the *exterior flame*, where the combustible matter coming from the candle has ceased to attract oxygen. The heat required for this is only that of incipient redness; and one of the larger orifices is best for producing this temperature.

"Reduction requires a more elevated temperature, which is best obtained by one of the finest orifices, which should be introduced only within the edge of the flame. A less distinctly blue cone than in the former instance, surrounded by a more brilliant one will be the result. The matter to be deoxidized is to be supported completely within the bright flame just beyond the apex of the blue cone: in this part there is inflammable gas which, of course will take oxygen from the substance to be reduced."

The size of the mass to be heated, including the flux when one is used, should not exceed that of a pepper corn, and when the substance is to be heated alone, the piece should not be much larger than a pin's head.

To support the trial piece, various substances are used; such as charcoal, platinum wire or foil, small cones of clay, or in fact any substance which is infusible and a bad conductor of heat.

Charcoal is an excellent support in reducing operations, and whenever its actions will not *interfere* with the result desired. The best charcoal for supports is made from light porous wood such as pine, and it is important that it should be recently burned.

Platinum on account of its infusiblility and low conducting power for heat, is the best metallic support that can be used; and when slips of the wire or foil are inserted in glass handles they are very convenient, particularly when the action of fluxes is to be examined. The handles are easily made by drawing a quill tube to the proper size and then placing in one end of it the bit of platinum sealing it in its place by directing upon the glass, a flame, by means of a blowpipe.

When the platinum supports are used with fluxes, a little of the flux in powder is to be taken up on the extremity of the platinum which is slightly moistened to cause it to adhere; then introduce it into the flame and fuse it, and *while fused* touch it to the trial piece, or, which is more convenient, allow it to cool, then moisten it and touch it to the substance which will immediately adhere. If the same supports are to be used without fluxes then the trial piece may easily be attached by a little adhesive clay, moistened.

Pieces of glass tubes, about the diameter of a quill, and three or four inches long, are often used with the blowpipe; and are distinguished by the names "*open tube*" or "matrass," according as the tubes are open at *both* ends, or only one. They are often used to roast substances; or to expel from them some volatile substance which may either condense on the cool part of the tube, or else by its odor or some other characteristic property, be easily recognized.

In tube experiments the spirit lamp is generally used; for the reason that although it gives less heat than the oil lamp or candle, it possesses the advantage of not soiling the exterior of the tube.

The fluxes generally used with the blowpipe are *carbonate of soda*, *biborate of soda*, and the *double phosphate of soda and ammonia;* which for brevity are called "*soda*," "*borax*," and "*salt of phosphorus*." The last is also called microcosmic salt.

Black flux may also be used advantageously in certain cases, but a mixture of pounded charcoal with "soda" will supply its place.

Soda or carbonate of soda, by uniting with silica aids the fusion of refractory substances, and facilitates the reduction of metallic oxides. It also, on account of the affinity of sodium for sulphur, arsenic, &c. often acts to reduce sulphurets, &c. to the metallic state.

Borax.—This substance also assists fusion on account of the property it possesses of forming fusible salts with many substances which themselves are infusible. By the color of the glass produced, the nature of the metal or metallic oxide is known.

Salt of phosphorus.—When the substance is heated it loses its ammonia and is changed into a metaphosphate of soda, which unites with bases and forms fusible salts, liberating the acids with which the bases were combined. The characteristic colors of metallic substances are shown better with this substance than with borax.

The following table, from Necker's "Règne Mineral" shows the colors which various metals give with the three fluxes, when heated either in the oxidizing or reducing flame; and also shows the difference, if any, between the color of the glass when hot and when cold.

N. B. The letter H signifies hot glass,—C the *cold* glass.

Reaction of the Principal Metallic Oxides, with the three Fluxes, by the Blowpipe.

Oxides of	SODA.	BORAX.		SALT OF PHOSPHORUS.	
		Oxidizing flame.	*Reducing flame.*	*Oxidizing flame.*	*Reducing flame.*
Chromium.	H. Orange. C. Yellow. In reducing flame. Green.	H. Yellowish brown. C. Colorless or slightly green.	H. Emerald green. C. Colorless.	H. & C. Green.	H. & C. Green.
Antimony.	H. Colorless. C. White.	H. Yellow. C. Nearly colorless.	H. & C. Opaque, grayish.	Colorless.	Colorless.
Titanium.	H. Dark yellow. C. White or grayish.	H. Colorless. C. Opaque white.	H. Yellow. C. Violet amethyst or blue.	Colorless.	H. Yellow. C. Beautiful violet.
Manganese.	H. Transparent green. C. Bluish green.	Amethyst.	Colorless if suddenly cooled.	Amethyst.	Colorless.
Cobalt.	H. Red. C. Gray.	Blue.	Blue.	Blue.	Blue.
Nickel.	Insoluble in the flux.	H. Orange or reddish. C. Yellowish or colorless.	Opaque, grayish.	H. Orange or reddish. C. Colorless.	H. Orange or reddish. C. Colorless.
Iron.	Insoluble in the flux.	H. Dark red. C. Yellowish or colorless.	Bottle green.	H. Dark red. C. Colorless.	Bottle green.
Zinc.	Insoluble in the flux.	H. Colorless, transparent. C. White, opaque.	Sublimes, & deposits a white powder on the charcoal.	Same actions as with borax.	
Lead.	H. Colorless, transparent. C. Yellowish, opaque.	H. Yellow. C. Colorless.	Partly reduces.	Colorless.	Does not reduce, colorless.
Copper.	H. Green, transparent. C. Colorless, opaque.	Green.	H. Colorless. C. Cinnabar red.	Green.	H. Colorless. C. Cinnabar red.

The mode of recognizing various other substances in minerals, by means of the blowpipe is given below.

If a mineral containing water be heated in a matrass, the water will be expelled, and condensing upon the cool part of the tube will appear like dew. If the water was chemically combined, some striking change in the appearance of the mineral will generally be observed, such as loss of transparency, change of color, &c.

When sulphurets of the common metals, are heated in the open tube, the odor of sulphurous acid will be perceived at the upper orifice; and a slip of paper stained with decoction of Brazil wood, if placed in the tube, will be turned yellow or bleached.

If sulphates are melted with a glass of *silica and soda*, a sulphuret of sodium is formed which communicates to the glass a *characteristic brown color*, like that of liver of sulphur.

Chlorides melted with a mixture of *salt of phosphorus* and *black oxide of copper color* the *flame, blue or green.*

If *fluorides* are heated with *salt of phosphorus,* in the open tube, *hydrofluoric acid* escapes, which *corrodes the glass* and turns Brazil paper yellow.

If *phosphates* are melted, by a good fire of reduction, on charcoal, with *boracic acid,* and a small piece of *iron wire* is plunged into the globule, it is *partly oxidized* at the expense of the phosphoric acid, and dissolved; while the *remainder forms* a *phosphuret of iron,* which by breaking the globule, will be found as a more or less brittle mass. If phosphoric acid were not present, the iron wire will be found unaltered.

If *nitrates* are heated in the matrass, with a drop of *sulphuric acid,* they are decomposed with evolution of nitrous acid fumes, which may be recognized by the color, and by *turning* to *black,* small scales of the *cyanohydrargyrate* of *iodide* of *potassium* previously placed on a dry part of the tube.

If *boracic acid,* or the *borates* are melted with *Turner's reagent* (a mixture of one part of fluoride of calcium and four and a half of bisulphate of potassa) a brilliant *green color* will be given *to the flame.*

Ammoniacal compounds when heated in the open tube with *fixed alkaline bodies,* (as lime or potassa) *give off ammonia* which will be recognized by its odor, &c.

Potassa gives to the brown glass of borax and oxide of nickel a blue color which soda will not.

The *salts of soda* color flame, a rich yellow.

Lithia attacks platinum foil and leaves a dull yellowish trace; and minerals containing it, give at the *moment* of fusion (especially if mixed with fluor spar) a red tint to the flame.

Most of the *salts of strontia* impart to flame a fine red color.

Many *salts of lime* give to flame a brownish red color.

Substances containing much alumina, when moistened with *nitrate of cobalt* and heated, assume a *beautiful blue color.*

Magnesia gives with nitrate of cobalt a pale rose color.

When substances contain much *silica* they will, when *fused with salt of phosphorus,* form a spongy mass or *skeleton* in the *middle of the globule* of glass; but if the silica is in small quantity its infusible particles in place of forming a skeleton, remain diffused through the glass and impair its transparency, giving it an opaline appearance.

Arsenical compounds heated alone on charcoal, or in the open tube with *black flux* give the *odor of garlic.*

Antimonial compounds may be recognized when heated in the open tube, by giving white fumes which are easily driven by heat from one part of the tube to the other, and have not the odor of garlic.

The *compounds of mercury* heated in the matrass with lime or iron filings, yield metallic mercury which sublimes.

The principal ores of *lead and silver* are easily reduced on charcoal alone, and with still more ease, with a little soda.

This list might be much extended, and other characters might be mentioned for many of the substances; but it is believed best to give only those which are most important, and easily remembered.

By applying the principles of chemistry, many other processes will suggest themselves to the intelligent student and as Bergman remarks "celui qui apporte dans ce genre d'experiences une main habile, se fraye tous les jours, de nouvelles routes qui conduisent toutes a la verite."

Art. XIV.—*Notice of the Gold Veins of the United States' Mine near Fredericksburg, Va.;* by Lt. M. F. Maury, U. S. Navy.

TO THE EDITOR.

Dear Sir—A mutual friend informs me that you have mislaid, or lost, your notes on some of the gold mines in this vicinity; he has requested that I would supply the deficiency; this I cannot pretend to; but as I was with you when you visited the United States' gold mine last summer, I may be able to embody some facts and circumstances, which will bring to your memory the striking features of the lost notes.

If you recollect there are several veins at this mine, which *strike* and *dip*, each in a different direction; the former (the *strike*,) is tortuous, and the angle of the latter is not constant.

The general course of vein No. 1. is about N. E. and S. W., it passes through a micaceous slate, which, near the surface, is soft and fissile, being easily removed with the pick; but at the depth of one hundred and twenty feet, it loses its fissility, and passes into a hornblende (?) slate, which is very compact and is with much difficulty removed by blasting.

Near the surface, the vein dips to the west at an angle of 54° with the plain of the horizon; but as it gains in depth, it curves, gradually approaching a perpendicular, until at the hundred and twenty foot level, (the lowest point at which it has been cut,) where it makes an angle of 20° with a perpendicular.

The vein conforms with the stratification of the slate, the *smooths*, or faces of which, sometimes form, for many feet, regular and beautiful walls to the vein, which walls are as smooth as though they had been chiseled; and were it not for their inclination, the *sides* of the tunnel at such places might be likened to the black walls of a large and narrow dungeon.

The matrix of the vein is quartz, cellular and laminated; the joints or faces of the laminæ being thinly coated with the capel (?) (decomposed shale,) of the lode, and sprinkled with argentiferous galena, blende, (the *black jack* of miners,) and sulphuret of iron; frequently spangles of gold may be seen lodged in the slate, when the quartz is just from the mine, or is freshly cleft. It is difficult to preserve such specimens, for when exposed to the air, whether in the pile, or in the cabinet, the shale already disintegrated and nearly in the form of clay, becomes dry and loses its consistency, when the gold, having nothing to support it, falls off. In juxtaposition to the pyrites, irregular crystals of the ferruginous sulphuret of copper are occasionally seen, which from their peculiar yellowish hue, are often taken for gold. Some specimens on their faces of cleavage are studded with perfect and beautiful crystals of the phosphate of lead; these surfaces are frequently variegated with tints of black, brown, purple and yellow; and the green acicular prisms grouped in circles, lines and broken curves, present the appearance of crescents, flowers, etc. raised on the quartz in fancifully embossed work of green moss. The molybdiate and venidiate of lead are also found in this vein.

The thicknes of the vein is variable; at some places it is near three feet, at others it thins out into a mere *thread* or seam, then widens again. After being cut by a *cross-course* of pure white quartz, it thinned out, and entirely disappeared for a few feet. Here its course was marked by a black seam between the walls; after driving a few feet on this seam, the vein was found replacing it.

At the time when the fissure which contains this vein, was formed, causes existed, to prevent regularity in the angle of inclination, as well as in the course of the vein. At one place in the eighty foot level the vein deflects from its course, forms almost a semicircle, and again comes into its former line of bearing. Above this deflection, the course of the vein in the forty foot level is continuous and there does not appear to have been any interruption in its angle of inclination, or in its line of bearing.

The other veins have an average thickness greater than that of No. 1. They are walled up near the surface in red clay, a perpendicular escarpment of which shows a succession of black lines or seams, in the regular order of stratification. Suppose a bed of gneiss to be converted, without undergoing the process of disintegration, into a mass of clay, or red earth, and that the lines showing the stratification of the gneiss were to assume a blackish hue, and be retained in the clay, and you would have a formation similar to that of which I am now writing. Disseminated through this clay, are numerous *untriturated* and angular fragments of translucent quartz, the largest of them attaining to the weight of only a few grains.

Veins Nos. 2. and 3. are parallel or nearly so; their general course is N. by E; they dip to the east. No. 2. at an angle of 30° with a perpendicular. No. 3. is nearly perpendicular from the surface to the depth of twenty five or thirty feet; while at the depth of sixty feet it has a very great *underlay*, declining from a perpendicular at an angle of near 60°.

The two veins are about one hundred feet apart; The *country* between them at the depth of sixty feet, is very soft, not being firmer than quicksands. The angle of inclination of No. 2. is quite uniform. At the sixty foot level, instead of red clay, the veins are contained in decomposed gneiss, which retains its color and texture, but is quite friable, yielding as readily as the clay, to the pick. A shaft has been sunk perpendicularly on No. 3. vein to the depth of twenty five or thirty feet; in this the vein declines from a perpendicular at a very small angle, say 5°; immediately under this shaft, in the sixty foot level, the vein inclines at an angle of 45°. I shall not offer at this time any conjecture as to this anomaly in the dip of veins. When the ore between the sixty foot level and the surface, is taken down, this very great underlay will doubtless be found to commence at, or near, the junction of the gneiss with the superincumbent clay. Circumstances which will throw more light on the subject may be then brought to view. Could it have been that the *soft country*, or quick sands alluded to, were not sufficiently firm and compact to support the vein in its nearly perpendicular position, and that for the want of proper support, it has fallen down as it were? Veins usually underlay more near the surface where the ground is less firm, than they do in depth, where they pass through rocks and a harder country; such is the case with No. 1. vein, and it is conformable with the laws which veins in their dip usually follow. In miners' phrase the country between the depths of forty five and sixty feet and about these veins, has been much *confused.* No. 2. vein has a *heave* of about five feet to the west. Here there are countless threads of the vein, some a foot, others a yard, and others a fathom or more in length, and an inch in thickness, laying horizontal and *across* the course of the vein, as if this had been suddenly broken asunder and violently thrown one side, leaving fragments strewed along its track. Threads of similar quartz frequently accompany the vein, but instead of laying horizontally and across its course, they diverge from it, run parallel to it with nearly the same inclination and finally come into the vein again.

Opposite to this heave, I expected to find a corresponding, or the marks of a corresponding heave in No. 3. vein. But instead of that, the country was more firm, the stratification of the gneiss was undisturbed, the vein thinned out and entirely disappeared; it was replaced by *killas* which marked its course for more than forty feet, when the vein again formed, being much richer here than it was where it disappeared.

The quartz from each of these veins has very much the same appearance and the same accompanying minerals. With a slight blow on its vertical edge, its tendency is to cleave readily into rhomboidal plates, but the cross cleavage not being perfect it divides into irregular oblong plates, the faces of which are mottled with the black oxide of manganese under the dentritic form, many of them presenting, with a little aid from fancy, beautiful landscape views in miniature.

Most of this quartz is translucent; it fractures with almost a milky whiteness. In some specimens the gold may be seen *within* the gangue, relieving its whiteness with delicate orange colored spots. Here the sulphuret of iron is more rare, blende and galena are seldom seen, while pyritous copper and malachite are more abundant; spots of black tourmaline are occasionally seen; and the iron pyrites assume a reticulated appearance.

Vein No. 4 lies W. N. W. and E. S. E. and dips to the north. It is between four and five feet thick. The quartz is similar in its tabular structure to that from veins No. 2 and 3; but the associated minerals of those veins, excepting the iron, are wanting here. The cubes of sulphuret of iron, in the middle of compact (externally) masses of gangue, have slowly yielded to the action of a destroying cause; their materials have gradually assumed a gaseous or more subtile form, and by permeation, or some other mysterious process, they have passed off, leaving a stain of iron upon the quartz, and oftentimes a spangle of gold glittering in the cubical cell which the pyritous crystal formerly filled: sometimes the interior of the rock is completely honeycombed by these empty cells. This vein has not been extensively explored. It dips at an angle of 45°, and like Nos. 2 and 3 is found passing through a stratified red earth, that contains numerous angular fragments of translucent quartz. The sulphate of baryta is one of the associated minerals of vein No. 1.

These veins, striking on different courses, and dipping at various angles and in different directions, cross each other at several points, forming thereby a sort of *veinous net-work* over the company's lands. Such is the character of *retiform deposits*, whether the veins be true, or contemporaneous veins. And such is the tendency of the veins at several other mines which I have visited. The establishment of the fact, whether or not the gold region be a *retiform deposit*, would be an important point gained in the economy of gold mining in this country. This is a task which belongs to others, and to them I shall leave it.

Parallel to the "gold belt" of Virginia, and running along its eastern borders, is a deposit of iron ore, which is not second to the gold region, either in value or importance. The ore is a *brown hematite*, of superior quality. It yields an excellent gray iron. Previous to the Revolution, several furnaces were supplied from it, but almost the only record which we have of their existence is found in their ruins; the piles of scoria, the extensive forests of second growth, numerous excavations, and mounds of earth, are the only monuments which tell of their former operations and prosperity. The beds were mined in a very loose way, and the ore extracted does not obviously lessen its abundance. The deposit passes with the gold belt out of the state, and perhaps continues with it throughout its range.

It is not improbable, that upon examination, the geological position of the coarser but more useful metal, with regard to the more precious, will be found useful in an economical point of view. The field of my observations is a small one, but I do not know of any mine of "vein gold" to the east of the iron range. There are several alluvial deposits of gold to the eastward of it; they are known under the name of *deposit* or *surface* mines; they are worked with profit. The gold has probably been brought to them, by the agency of water, from veins to the westward of and above the iron belt. It would be a striking feature in the geology of the state, should deposits of the two most extensively distributed metals in nature, be found in juxtaposition to each other, for many miles, each marking the limits of the other, without ever encroaching upon its borders.

Art. XV.—*Chronometers.*

Having in Vol. xxix, at p. 279 of this Journal given publicity to the experience of those eminent chronometer makers, Messrs. Parkinson & Frodsham, of London, we now readily extend the same courtesy to Messrs. Arnold & Dent,* of that city; aware also that, after Great Britain, no country has so deep an interest in chronometers as this, for every sea is whitened by our canvass.

The following passage from Obed Macy's History of Nantucket describes the case of many thousands of our countrymen.

"The wide ocean is the source of their livelihood, and they breast its waves and grapple with its monsters, in every latitude between the polar ices. The sun never sets on their industry; they labor and worship under the whole dome of the firmament. The objects of their affections are abroad on the deep, or buried forever beneath its billows; their prayers are wafted on every wind and their tears are mingled with every surge."

To these adventurous labors of the intrepid whalemen, the chronometer is indispensable, for the longitude, and it is said that New Bedford, the neighbor and friendly rival of Nantucket, has the time keepers at this moment to the amount of $87,000.

On the Application of Glass, as a substitute for Metal Balance Springs in Chronometers.

[From the Nautical Magazine, for December, 1836.]

Sir,—On several occasions we have occupied a space in your valuable journal with some account of experiments which we have made,

---

* Note from Messrs. Arnold & Dent, dated London Dec. 8, 1826.—Messrs. Arnold & Dent beg to present Prof. Silliman with an account of their experiments on metal and glass balance springs of chronometers, and also the official rates of two chronometers having glass balance springs and balances, *tried* by order of the Lords Commissioners of the Admiralty.

with the view to introduce glass into the manufacture of chronometers, as a substitute for steel and brass in the balance and balance-springs of those machines. After a trial of more than three years, conducted at the Royal Observatory by the direction of the Lords Commissioners of the Admiralty, with two chronometers of this new construction, we have requested that they may be returned to us for further improvement. Thus the first public trial of the glass spring and its balance may be considered as closed; and with your permission, we will here briefly advert to some of the progressive experiments with it, which have been detailed in former numbers of your work, beginning with a short statement of the first application of a balance-spring to a watch.

About the year 1660, Hooke first applied a spring to the balance of a watch, so that the vibrations were returned. It also admitted of the watch being regulated, and it remains *the same* at the present time in watches, as when he first applied it. Its form is that of a flat spiral, and made of steel. The effect of heat on this spring will be seen in one of the following tables, which for 68° of Fahrenheit, amounts to 385 seconds in 24 hours. To reduce this quantity, our present experiment with glass *is the first* that has been made.

While at the temperature of 68°, the error from a steel balance and spring is 385 seconds in 24 hours; that of glass is only 40 sec. It is also clearly desirable to introduce a balance-spring the elasticity of which is not produced by any chemical or mechanical process, and which is free from magnetic influence, and capable of resisting the effects of corrosion. By its adoption, the principle of the chronometer is altogether changed; and it is remarkable, that while the improvements of the mechanism in a chronometer have been many and various, the present is the *only* attempt to reduce the errors of the balance-spring, or, in other words, to reconstruct the chronometrical part of the machine *de novo*, and however chimerical the introduction of glass appeared in the first instance, it will be seen that we have made considerable advancement in the three years' trial. In that period it has undergone the most severe test from the discharge of guns on board ship, it has also been continually going for upwards of three years without fracture, and, we may add, has been of great service to Captain Hewett in his survey of the North Sea. This officer states, in a private letter accompanying his official report on it, "that the daily rates derived from the comparison with his standard chronometer, perhaps never were excelled in chronometrical journal."

The obstacle which seemed to present itself to the use of glass in the chronometer was its extreme fragility; this however, proved to be no obstacle, and having prepared a glass balance spring, we took a previously adjusted chronometer, having a hardened and tempered balance spring of steel, and having registered its arc of vibration, which was 180°, from the point of rest, we removed this spring, and applied one of glass. The vibrations were immediately increased to an arc of 200°, thus proving that glass had greater elastic force than steel, for the weight of the balance was not disturbed by the application of the glass spring, and the arc of vibration being increased and the same time preserved, its strength was necessarily equal to the original one.

Satisfied thus far with our efforts, we took it to Captain Beaufort, the hydrographer to the Admiralty, who promised us his assistance in obtaining their lordships' order for any trial to which we might wish the experiment to be subjected in our progress. Thus encouraged, the necessary adjustments for temperature, &c. were commenced.

Two important questions suggested themselves at this early stage of the experiment. The first was to ascertain how far a low temperature would affect the fragility of the glass spring; and the second was to prove by experiment whether it would withstand the shock arising from the discharge of cannon.

To determine the first question, we placed the chronometer in a temperature of 12° Fahrenheit. In speaking of this low temperature, it may not be considered as digressing too much to explain the manner in which it was obtained; and we may be allowed this opportunity of describing our method of procuring a low temperature even during the summer months. The chronometer submitted to the process is placed in a metal vessel, having a piece of glass in the top, to allow a thermometer in it to be read, and the chronometer to be compared. This vessel, which we may call the internal one, is placed in an outer one similarly constructed with a glass top, but having a space completely parted off within it at the distance of an inch and a half from its outer sides. The distance thus left being occupied by common air, prevents the exterior atmosphere from readily acting on the ice which is to be contained within the partition. The inner vessel containing the chronometer is then placed in the centre of this outer vessel, and kept in its place by blocks of wood, and the space between it and the partition above-mentioned is filled with ice and salt mixed together. The whole is then placed in an outer wooden vessel, which is subsequently incased in flannels. By this arrangement a low temperature may be preserved for many hours. The chronometer with the glass balance spring was placed in a vessel of this description, and the thermometer soon fell to 12° of Fahrenheit, at which it continued, with little variation, during the first twelve hours; at the end of twenty-four hours the thermometer was at 28°. The result of this experiment we considered satisfactory as to the power of the glass spring to resist the effect of a low temperature. To enable us to determine the second question, namely, the power of resisting the shock arising from the discharge of cannon, the lords commissioners of the Admiralty were pleased to order the experiment to be made on board H. M. S. Excellent at Portsmouth. The Rev. George Fisher superintended these experiments, and their results are shewn by the following.

TABLE I.

13 Sept. 1833.	Distance of Chronometer from a 24lb. gun, shotted.	Number of discharges.	Situation of Chronometer with respect to gun.	Effect produced on Chronometer.
Expt. 1	42 feet	3	Placed bare on the deck abreast of gun.	None
2	32 —	3	Do.	Do.
3	20 —		Do.	Do.
4	15 —		Do.	Do.
5	12 —		Do. on the carriage of the adjacent gun.	Do.
6	Broadside from the main-deck guns shotted.		Do. on the lower deck, 9 feet below mid-ship main-deck gun.	Do.

Signed, GEORGE FISHER.

Having by these experiments established the conclusion, that the fragility of glass was no obstacle to its application to the purpose of forming the balance spring of a chronometer, our next step was to ascertain at what degree of tension a glass spring would break. We made a glass spring for this purpose, and applied it to the balance of a chronometer. It was wound up to 360°, detached from the escapement, and suddenly released, being shortened one coil at each trial. The following table will shew the result:—

TABLE II.

Degrees of Tension.	Number of turns in Spring.	Results.
360°	12	None
Do.	11	Do.
Do.	10	Do.
Do.	9	Do.
Do.	8	Do.
Do.	7	Broke

As chronometers vary in their arcs of vibration from 180° to 220°, and as the glass spring was wound up 360°, and did not break until it was shortened to seven coils, we may fairly conclude that it would have performed the usual arc of 180°, even at the seven coils, without fracture. It will be remembered, that the glass spring was applied to a previously adjusted chronometer in our few first experiments; and in adjusting it for variation of temperature, we found that we had to deal with a substance, with the nature of which we were altogether unacquainted; for on applying the glass balance spring, an excess of compensation was found, and, after repeated alterations to reduce this excess, we applied the least compensation that could be afforded us by the usual balance. This was done by placing the whole of the compensating weight at the end of the arm of the balance, instead of attaching it in the usual way to the movable end of the arc of compensation, and, as the arm expands in a direct line from the centre of the balance, we supposed that our object would have been accomplished.

Having now only the compensation rim composed of the usual laminæ of brass and steel, and the weight being also placed at the extremity of the arm, where no curvature could be produced, to bring it nearer the centre, we found that the laminæ themselves, without any weight, produced an excess of compensation; we therefore determined on finding the amount of error in time arising from the spring when subjected to a variation in the thermometer from 32° to 100°, To arrive at this, we made a solid disk of glass, and, having removed the former balance, we applied the disk in its stead, and brought the chronometer under this arrangement to mean time at a temperature of 32°. Assuming that no error would arise from the glass balance by its diameter being increased by heat, the variation shewn when the thermometer was raised to 100° would be attributable to the glass spring only.

The temperature was raised to 100°, when to our astonishment, the chronometer lost only the small quantity of forty seconds in twenty-four hours: the experiments were repeated, and the same results obtained.

It next became an object of much interest to find the amount of error of a steel balance spring under similar circumstances. With this view, we removed a compensation balance from a chronometer, and replaced it with a glass disk. Having brought it to mean time at 32°, we raised the temperature to 100°, and the rate shewn was losing 385 seconds in twenty-four hours. We then followed up these experiments by trying a gold balance spring; also one of palladium; and their several results are shewn in the following table: the number of vibrations were 18,000 when the chronometer shewed mean time.

Metals.	Thermometer.	Loss in twenty-four hours.	Length of Spring.
		m. s.	Inch.
Gold	32 to 100	8 4	14 00
Steel	Do.	6 25	11 04
Palladium	Do.	2 31	11 34
Glass	Do.	0 40	15 00

This table shews that metal balance springs vary in their results, when under different degrees of heat, in the order in which they stand in a table of expansions; and with this conclusion we might have remained satisfied, had there not been such a wide difference between the results with the glass and the gold springs. This at once led us to consider that such a difference could not arise entirely from an increase of length in the springs caused by direct expansion, but principally from a loss of elasticity occasioned by change of temperature.

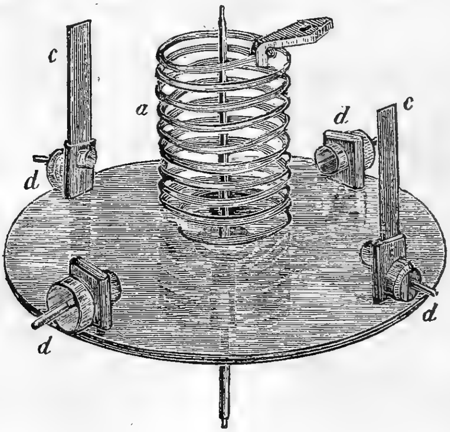
Our attention was next directed to separate these two causes of error, and if possible to account for the anomaly between the glass, steel, and gold balance springs. We may naturally conclude, if these alterations in the rates of the chronometers arose entirely from an increase on the length of the balance spring, due to the change of temperature, that by shortening the spring by the same quantity by which it had been augmented by the increase of temperature, a very near correction would have been effected, (making an allowance for a very small change in the inertia of the balance.) This was by no means the case; the following experiment will shew that it arose principally from a variation in the elastic force of the springs.

We first measured the length of the steel spring, and, on referring to a table of expansions, we found that being 11.04 inch in length it would increase its length .0065, in a temperature from 32° to 100°. This quantity being so small, we therefore preferred .01 inch, being in excess of that given by the table. Having shortened the spring by this quantity, which we could determine by our gauge, and keeping the glass disk applied, we obtained the difference occasioned thereby in the rate of going at 32° and 100°, then reasoning from the table of expansion, that as the spring had lengthened .0065 inches, it was fair to conclude that we had reversed the order of going, and that the chronometer would then go at the same rate when at 100° that it had gone before 32°. Instead of this, we had only advanced towards it by less than one fourth part of the quantity, shewing that the variation in the rate of going arose chiefly from a diminution of the elastic force of the spring, as seen in the following TABLE—

Thermom.	Rate per hour.	Remarks.	Experiment.
	s		
32°	+ 5 . 74	Length of steel spring, 11.04 in.	1
66	— 1 . 80	Do.	2
100	— 10 . 30	Do.	3
100	— 7 . 0	Spring shortened, .01 in.	4

Having shortened the spring for the fourth experiment, by .01 inch, if the difference of rate had depended on its length, it would have shewn the original rate of $+5^s.74$ at 100°; instead of this, the rate was $-7^s.0$, differing only $3^s.3$ from the former at the same temperature. To the decrease in length of .01 inch, therefore, is due the loss of $3^s.3$, while to the loss of elasticity is due the difference between $3^s.3$ and $16^s.04$, the whole difference of rate for 68°, i. e. $+5^s.74$, at 32° and $-10^s.30$ at 100°.

The fact having been proved, that glass does not lose its strength by heat in the same ratio as metals, and being now acquainted with the extent of its loss, which was 40^s for 68° of Fahr. we next had to construct a balance suitable to correct so small an error, and our previous experiments having pointed out to us that a metallic balance was unfit for such a purpose, we continued to employ the glass disk *b*, as shewn in the annexed diagram—



to which was attached the glass balance-spring *a*. To the disk we applied in an horizontal position, two laminæ composed of platina, *c, c.* These pieces were in length 0.5 in., breadth 0.052 in., thickness 0.004 in. and weight 2 grains. The lightness and thinness of these pieces only allowed of one method of compensating for temperature, which was to cut off with a pair of scissors a small portion from the top, and to draw out the timing screws *d, d*, to bring the chronometer to mean time again, in consequence of the balance having been lightened by cutting off a piece from the compensation laminæ.

The compensation being completed, we next proceeded to test the isochronism of the glass spring; in which respect it was proved to be as perfect as any metallic spring. The whole of the adjustments being now completed, we finally tried its rate under different degrees of heat, from 12° to 100° Fahr., and are of opinion, that there was less error shewn than generally attends metal springs, under corresponding circumstances. The chronometer with this glass spring and balance, was sent to the Royal Observatory, agreeably to the order obtained from the lords commissioners of the Admiralty, in October, 1833.

There have been two causes why the investigation has been delayed; first, until the last winter, the thermometer did not fall sufficiently low to enable us to draw a fair conclusion; secondly, there has been an acceleration, on a gaining rate, since it has been placed on trial; and this has been the sole obstacle to the complete success of this experiment. This acceleration must, therefore, be a subject of further research: that it arises from some latent cause, would appear from the circumstance, that the two chronometers, placed on trial by order of their lordships, as well as others which we have had in our possession for private experiment, have gained nearly in the same ratio. Of the two chronometers tried by order of their lordships, No. 616 has been stationary at the Royal Observatory, and No. 790 on board H. M. S. Fairy, Capt. Hewett, employed in surveying in the North sea. On the close of the season, this latter chronometer was returned to the Royal Observatory, until required; therefore, (with regard to this chronometer,) we have both a sea and land rate. The annexed tables shew the going of the two chronometers. From these tables it appears that the chronometers gained most at the earliest period of their trials, and our object is to watch the termination of their acceleration.

If we might venture to offer some practical remarks on the nature of balance springs which have been subjected to the effects of fire in their construction, to increase their elasticity, we would add, that all springs, which have been subjected to this process, have, for a certain length of time, a decided disposition to accelerate progressively; and it would therefore appear, that some particular change invariably goes on in the spring after the operation of exposure to the fire, the nature of which we are at present very imperfectly acquainted with; but, from the few experiments we have made, we are convinced that glass is in every respect capable of being introduced into the manufacture of chronometers.

Art. XVI.—*Chemical Examination of Microlite;* by Charles Upham Shepard, M. D. Professor of Chemistry in the Medical College of the State of South Carolina.

For my description of this mineral,* I could command only a few minute crystals, the largest of which weighed but four tenths of a grain. Had these not been possessed of considerable regularity of form and at the same time afforded very uniform results in the determination of their hardness and specific gravity, I should not have ventured on referring them to a new mineralogical species. The recent examination however of three crystals of the same substance from Chesterfield, each weighing about five grains, completely establishes the description already given, and enables me to throw some light on the chemical constitution of the species.

A. A very thin fragment of one of these crystals was heated before the blowpipe; it turned lemon-yellow at the apex, but without having suffered fusion. The same piece dissolved freely in borax with much effervescence, and formed a colorless, transparent glass.

B. 24·5 centigrammes of the mineral, in the state of an impalpable powder, were heated to whiteness in a platinum crucible. It lost 0·5 centigramme; i. e. 2·04 p. c.

C. Another portion in powder was treated with sulphuric acid in a glass tube, and heat applied. No perceptible corrosion of the glass was observed.

D. A few centigrammes were digested, first in dilute hydrochloric acid and afterwards in dilute *aqua-regia* during several hours. The mineral was not sensibly attacked.

* American Journal of Science and Arts, vol. xxvii. p. 361, and my Treatise on Mineralogy, Part second, vol. ii. p. 45.

E. 11·5 centigrammes of the ignited mineral (B) were mingled with 25 centigrammes of carbonate of potassa and heated to whiteness for fifteen minutes. An imperfect fusion in the mixture was the result. The porous mass assumed a pale bluish color. On the addition of water, it became obvious that but a small portion of the mineral had suffered decomposition. It was accordingly treated to a new portion of the alcaline carbonate, and the crucible maintained at a white heat for one hour. The fusion was now complete, and the mass on cooling assumed a delicate sky-blue color. It was separated from the crucible by means of dilute acetic acid.

F. The clear acetic solution gave no precipitate with acetate of lead, thereby evincing the absence of phosphoric acid.

G. Hydrosulphate of ammonia occasioned no troubling in the acetic solution, from which the absence of iron was inferred.

H. Oxalate of ammonia produced a cloudiness and a precipitate in the acetic solution; which was occasioned, as afterwards became more apparent, from the presence of lime and yttria.

I. The matter undissolved by acetic acid was digested for some time with hydrochloric acid. A part of the solution, on being treated with the hydrosulphate of ammonia, yielded a black precipitate which was insoluble in excess of the precipitant. It was therefore attributed to protoxide of uranium in the mineral.

J. The residuum left by the hydrochloric acid in I, was digested in hydrosulphate of ammonia. The solution was separated by the filter, and evaporated to dryness. Ammonia was added to the residuum and the clear solution treated with nitric acid; a yellow precipitate fell. Tungstic acid is consequently an ingredient of microlite.

K. Another portion of the hydrochloric solution (I) was treated with a crust of sulphate of potassa crystals and set aside for twenty four hours, at the expiration of which time a perceptible accumulation of fine white grains was perceived, thus proving the presence of one or more earths, forming double salts with sulphate of potassa.

L. The residuum after digestion in hydrosulphate of ammonia, (J,) was fused with six times its weight of carbonate of soda and heated to whiteness. To the clear solution obtained by boiling water on the fused mass, nitric acid was added. A heavy white precipitate fell; nitrate of silver also threw down a precipitate, which was insoluble in nitric acid. Tartaric acid produced no troubling in the aqueous solution. Columbic acid was thus found to be a constituent of the mineral.

Analysis.

A. 0·33 gramme of the mineral in the state of an impalpable powder was treated in a platina crucible with 1·50 bi-sulphate of potassa. After fusion for a few minutes over an alcoholic lamp, the crucible was carried to redness in the furnace. The color of the fused mass was yellowish white.

B. Water was boiled on the fused mass (A,) and the contents of the crucible transferred at once to a filter. The clear solution that passed through was treated with solution of sulphate of potassa. In fifteen minutes, a fine white granular precipitate appeared.

C. The insoluble powder, B, was treated with sulphohydrate of ammonia. Its color was thereby changed to greenish black with a tinge of blue. Hydrochloric acid was poured on until the powder became nearly white. After washing in boiling water, it was transferred to a platina crucible and after ignition weighed 0·37 gramme.

D. The ignited powder, C, was boiled for a few minutes with excess of carbonate of potassa, and then treated with hydrochloric acid, filtered, washed, dried and ignited. It weighed 0·255 gramme. A portion of it was fused with carbonate of soda before the blowpipe. The bead effervesced, and on cooling, became white and opake. Another portion was fused with borax. It gave a clear bead, and by flaming became white and opake.

E. The hydrochloric solution, D, was precipitated with oxalate of ammonia and the precipitate was heated to whiteness. It weighed 0·04 gramme.

F. The water boiled on the fused mass of the mineral and treated with solution of sulphate of potassa, B, was separated from its crystalline precipitate by means of a filter and set aside after having had its volume augmented by a saturated solution of sulphate of potassa. In a few days a precipitate of fine granular white crystals appeared. The fluid was treated with an additional quantity of sulphate of potassa, whereby the white precipitate was in part, perceptibly dissolved. The clear liquid was withdrawn and treated with ammonia. A light yellowish white flocculent precipitate appeared, which on ignition was greyish white, without a tinge of red. The quantity was too small to allow me to make any satisfactory experiments upon it; but the fact that the double salt it formed was not soluble in the solution of sulphate of potassa, shows that it could not be thorina or zirconia, while its not turning red on ignition proves that it was not oxide of cerium.

G. The precipitate not taken up by the solution of sulphate of potassa, F, was treated with hydrosulphate of ammonia and then with dilute hydrochloric acid. The hydrochloric solution was treated with solution of potassa and the precipitate ignited. Its color was greyish white, without a tinge of red. It weighed 0·03 gramme.

The foregoing results do not enable me to rely with confidence on the proportion of any ingredient except the columbic acid. The other principles I regard only as having been ascertained approximatively.

Columbic acid,	75·70
Lime,	14·84
Tungstic acid, Yttria, Protoxide of uranium,	7·42
Moisture,	2·04

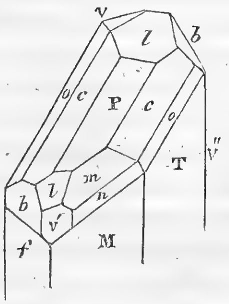
Charleston, Feb. 10, 1837.

ART. XVII.—*Notice of Eremite, a new Mineral Species;* by CHARLES UPHAM SHEPARD, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

PRIMARY form. Right oblique-angled prism. M on T=140°30′.

Secondary form.

M on T	140°30′
P on M, or P on T	90 00
M on f	92 10
—— n	149 20
—— m	130 20
—— b	125 20
P on l	150 50
—— m	138 45
—— b	127 10
—— v	139 30
—— v′	132 15
T on o	136 25
—— c	117 40
—— l	83 45



T on l′	96°15′
—— v′	118 30
—— v″	118 30
f on b	143 8
—— v′	118 17
b on l′	140 26
b on l	140 40
—— v′	141 16
—— v″	106 20
m on n	160 35
—— o	152 45
l on v	156 10
c on o	161 10
—— ç	151 35

Fracture conchoidal to uneven. Surface of the planes smooth and brilliant, T, M and b surpassing the rest.

Lustre resinous to vitreous. Color between clove and yellowish brown. Semi-transparent. Streak resembles color, but paler.

Brittle. Hardness=5·...5·5. Sp. Gr.=3·714.

Alone before the blowpipe, it instantly becomes transparent and colorless, but does not suffer the slightest fusion even in very thin fragments. Heated with carbonate of soda on a platina support, an opake white mass was obtained, stained in a single spot of a cinnamon brown color. With borax, it fused slowly, attended by a slight effervescence, and yielded a transparent amber-yellow globule, which by flaming became paler and milky in its clearness. Heated with sulphuric acid in a glass tube, after pulverization, it sensibly corroded the glass. It may therefore prove on more extended examination to be a fluo-titaniate, but of what base it is impossible to conjecture.

For my specimens of the above mineral, I am indebted to Mr. Thomas R. Dutton, a member of the senior class in Yale College. He discovered it last autumn in the northeastern part of Watertown, Conn. (on land of David Matoon,) engaged in a boulder of albitic granite, four feet in diameter. Mr. Dutton noticed the crystal figured above (which is still in his possession) while breaking up the mass for the purpose of obtaining black tourmaline, by which mineral the boulder was more or less penetrated. The crystal weighs but two grains, but is highly finished and perfect in its form,—all the faces admitting of the use of the reflective goniometer, by means of which instrument the angles quoted were obtained.

Mr. Dutton has again visited the locality this spring, and carefully reduced a part of the rock to fragments, without however being able to discover more than five or six extremely minute crystals, whose form is not very distinct. Two of these were employed in the blowpipe experiments above described. The mineral appears to be imbedded in the quartz and is accompanied by apatite.

As beds of this variety of albitic granite are common in the north part of Waterbury, in Watertown, Plymouth, and indeed generally throughout the mica-slate band skirting the frontier of the secondary in a northeasterly direction quite to the Massachusetts line, it is highly probable that other localities of this interesting substance will ultimately be brought to light.

The name bestowed upon the mineral is derived from ερημια, *solitude*, in allusion to the isolated manner of its occurrence, with respect to other individuals of the same species. Its properties obviously bring it within my genus eruthrone-ore, and in consequence of the replacement of both its longer and shorter terminal edges by three planes each, thereby giving rise to six prisms beside the primary, it may be designated systematically, *polyprismatic eruthrone-ore.*

New Haven, May 21st, 1837.

Art. XVIII.—*Description of Several New Trilobites;* by Jacob Green, M. D.

Genus Cryphæus—*Green.*

Body ovate oblong; convex; trilobate; contractile.

Buckler with two reticulated, oculiform tubercles.

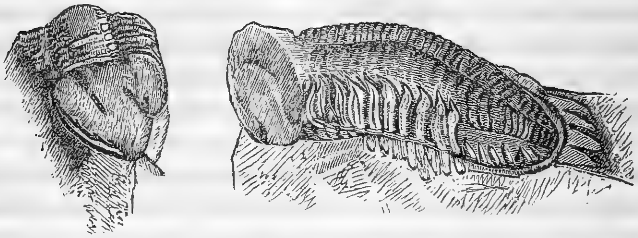
Arches of the lateral lobes sustaining a *second series* of ribs.

Tail elongated, membranaceous, lobate.

The generic term which we have applied to this proposed group of animal remains, is derived from the Greek, and is analogous in its signification to that of Calymene, Asaphus, Ogygia, and to some other appellations used by fossil zoologists. The head and the upper part of the body of these animals resemble those of the Calymene of Brongniart. A very slight obliteration of these fossils along the sides and round the tail, would give them all the characters of a Calymene, and perhaps some animals which have been described as belonging to that genus, will be found hereafter to belong to the present group. The genus Cryphæus is also, in some respects, very closely allied to Paradoxides, but as the *buckler* is furnished with tubercular oculiferous prominences, they cannot be confounded together. Professor Brongniart has indeed described, with a mark of doubt, the Paradoxides Laciniatus, as having eyes—*oculis marginalibus?* but should that interesting relique ever be discovered in a sufficiently perfect state to determine the question, it cannot, we suppose, be included in a genus, one of the principal characters of which is to be *blind.* Brongniart says of this group, "Les lobes latéraux (of the buckler) sons unis, et ne paraissent point porter d'yeux réels ni même de protubérances oculiformes." The P. Laciniatus is furnished with a lobate tail, somewhat like that of the Cryphæus, but it differs in many important particulars from any fossil that we have ever observed. Mr. De La Beche does not include it under that name in his list of Trilobites discovered in Europe, though according to Wahlenberg, it is found in Westrogothia. Professor Brongniart, has given, from Mr. Stokes, an imperfect drawing of a trilobite sometimes met with at Dudley in England, (plate 4, fig. 9.) which has some analogy in its form to the animals proposed to be arranged in our new genus, and Count Rasoumousky has figured and described a very remarkable relique, found on the Yaousa, near Moscow, which also has a somewhat similar aspect.

The second series of ribs, which proceed beyond the costal arches of the Cryphæus, we suppose will distinguish it from every other described genus.

Cryphæus *Boothii.* *Green.*



Clypeo antice rotundato; oculis magnis; rugis tribus in fronte lateralibus; articulis septemdecim; cauda serrata utrinque in dentibus quinque divisa.

The general contour of this trilobite is that of an elongated oval; the body projects in high relief above the rock on which it reposes, and its whole length is rather more than two inches. The buckler in our specimen is partly wanting, but the front and one of the cheeks are still in a good state of preservation, and afford a pretty accurate idea of the whole head.

The *front* rises above the surface of the cheeks, is rounded and broad at its anterior part and gradually tapers towards the middle lobe of the abdomen. It is distinctly divided from the cheeks, and has three furrows on each side, near its upper edge. The lower furrow is the longest, and is nearly on a line with the inferior edge of the oculiferous tubercles on the cheeks. The middle furrow is the smallest, and appears as a deep depression or pit. The upper furrow is rather above the superior edge of the eyes. The anterior margin of the front is marked by a long curved sulcus, which has the appearance of a *lip*, as in the Calymene of Blumenbach.

The *cheeks* are in the form of spherical triangles. The oculiferous prominences are close to the front, and are placed just within the internal obtuse angles. The reticulated structure of the eye is quite perfect on the lower portion of the tubercle which still remains.

We have described the above as the head of our trilobite, though it is detached from the body; but as it lies in the rock just before and in contact with the anterior portions of the animal, there can be little doubt that it once formed a part of it.

The articulations of the *abdomen and tail* cannot be distinguished from each other; seventeen may be readily counted, and though our specimen is not entirely perfect, this number probably includes the whole. The middle lobe is quite prominent; is nearly equal in breadth for about two thirds of its course, and then gradually tapers to an obtuse tip. Most of the ribs, or costal arches, are, in our specimen, beautifully distinct. There is a little furrow scooped out of the upper surface, commencing at the middle lobe and terminating near their outward extremities, which are rounded and separated from each other, forming on the sides of the animal a denticulated line. Beyond these costal arches, there projects a second series of shorter ribs; these commence between the outward extremities of the first series, and gradually widen towards their termination. These appear intended to support a membranaceous expansion round the body. Unfortunately our specimen is rather obliterated on the sides, but still small curved spinous prolongations, may be seen in some places to terminate the second series of ribs, and will probably be found, in more perfect specimens, to project beyond the lateral margin of the abdomen on both sides.

The *caudal end* is very peculiar. The last five costal arches of the tail, terminate abruptly in a narrow membranaceous edge, which appears to be continuous with the expansion that surrounds the body. Its external border is finely ornamented with five leaf-like scollops on each side; the points of the leaves are free, and all curve towards a smaller leaf or lobe, which originates from the central portion of the tail or terminal joint of the vertebral column. At the fifth costal arch, counting from the tail towards the head, where the leaf-like appearance of the caudal membrane commences, the second series of ribs, which rise between the extremities of the costal arches, terminates. In our specimen, but three of the leaf-like scollops on one side remain perfect; the origin of the other two is, however, very obvious.

This magnificent trilobite was found near the town of Huntingdon, in Huntingdon County, Pennsylvania, by Professor James C. Booth, to whose kindness I am indebted for an opportunity of describing it. The specific name is given in justice to the discoverer, whose eminent skill in geology, mineralogy, and in analytical chemistry, entitles him to a much higher distinction.

In the cabinet of my friend, Dr. R. M. S. Jackson, there is a fragment of this species displaying the remarkable organization of the caudal end, and a person residing at Huntingdon has another specimen; all were found in the same locality. The rock in which they occur is a ferruginous clay slate, filled with other petrifactions. My friend John F. Frazer, Esq. informs me that the geological structure of Huntingdon and its vicinity, belongs to the classification of rocks, called by Professor Rogers, in his annual report as State Geologist, the *olive slate stratum.* This stratum reposes on a coarse grained sandstone, full of organic remains, and is thus described in the report.

"The next stratum is a dull olive colored slate, alternating with grey argillaceous sandstones. Towards the upper portion some of the layers consists of a soft, very yellow slate, which increases as we ascend, becoming, in the upper part, the principal variety. It alternates with beds which gradually assume a brown and reddish tinge, that grows gradually more distinct, indicating the gentle passage of this rock into the red argillaceous stratum above it. The inferior layers contain occasionally large deposits of a very argillaceous iron ore, approximating in its composition and characters to the argillaceous iron stone of the coal measures. This stratum abounds also in mineral springs, the predominating ingredient of which is sulphuretted hydrogen. It may for convenience sake, be called the *olive slate stratum.*"

Cryphæus *Collitelus.* *Green.*

Cauda utrinque in lobis quinque divisa; lobis elongatis, rectis, acutis.

I have seen the caudal end only of this exceedingly interesting trilobite, but it differs so much from the other species described, that there is little doubt of its being distinct. There are eleven or twelve articulations of the vertebral column, and but five of the costal arches of the sides visible in our fragment. The joints of the middle lobe of the back are narrower, more numerous, and by no means so prominent as those of the C. *Boothii*, and the terminal joint is also much smaller. The costal arches or ribs of the sides are remarkably broad, and are strongly marked by a deep sulcus running along their inferior edge; they commence at the seventh joint of the vertebral column. The scollops or leaf-like lobes of the tail are five in number, and are remarkably large in proportion to the body of the animal; they form a regular continuation of the last five arches of the sides, and terminate in free points, without any curvature. A thin rib passes from the tip of each lobe through its middle to the sides of the animal, probably for the purpose of giving strength to the large development of the membrane. The body of the animal is broad, and a good deal depressed. The breadth of the fragment is one inch, and the length nearly half an inch.

I received this fossil from my friend, Dr. R. M. S. Jackson, of Alexandria, Huntingdon County, Pa. It occurs in a soft ferruginous slate, through which some sparkling particles of iron pyrites are sparsely disseminated. It was accompanied by five specimens of the C. *Boothii*, some of which were coiled up in the manner of the Calymene; the leaf-like lobes of the caudal membrane, in two of these specimens, were smaller than the middle leaf, and the outward angles of the buckler in one were perfect, extending down the sides of the animal, to the fourth abdominal articulation, where they finished in a rounded termination.

Trimerus *Jacksonii.* *Green.*

Clypeo? corpore convexo; cauda suborbiculari, costis lateralibus, abdominis, lineatis.

I have in my cabinet five or six specimens of this species, but they are all portions of the caudal end. The most perfect fragment consists of nine articulations of the middle lobe of the back, with eight costal arches. The middle lobe is regularly conical and much flattened, all the joints being broad and smooth on their upper surface. The ribs of the sides are also broad, but they are strongly marked by a raised line running through the middle of each; this raised line appears to characterize all the lateral ribs of the body, and where the crustaceous shell remains attached to the fossil, which is evident in two or three instances, this line is very distinct and peculiar. The grooves between all the joints are narrow and very slight depressions. The tail is rounded.

This species resembles a good deal the T. *platypleurus*, but the raised line on the upper surface of the ribs, will be sufficient at once to distinguish them from each other. It occurs in a hard, compact blackish limestone, in Huntingdon County, Pennsylvania. From the same locality I have the head of a Trimerus, which no doubt belongs to one of this species, but until it is found united to some other portions of the animal, its description must be deferred. The specific name of this trilobite I have given in compliment to the discoverer, Dr. R. M. S. Jackson, whose researches in fossil zoology will continue to illustrate many obscure departments of the science.

Asaphus *Trimblii.* *Green.*

Clypeo? Corpore depresso; costis planis, parte marginali vix membranacea; cauda rotundata? brevi.

Our fragment exhibits eleven articulations of the abdomen, and nine of the costal arches, all in a good state of preservation. It presents another example of the fact, that the ribs of the side lobes do not always correspond in number and position with the articulations of the vertebral column.

Like most of the fossil animals of this genus, the head is mutilated or lost; yet what seems to have been a small fragment of the *front* or middle lobe of the buckler, lies on the rock at a little distance from the abdomen. It is marked by two deep curved, transverse plicæ or folds.

The body is much depressed; the middle lobe is slightly conical, and terminates in a very obtuse tip; its articulations are all regularly rounded and smooth. The costal arches are also rounded, and without striæ, grooves, or pustulations, and have the same breadth throughout; the lower ribs are slightly curved, and they all terminate very abruptly in the membranaceous expansion. This organization of the Asaph is beautifully developed in our specimen;—the membrane is narrow, even and smooth along the sides of the body, forming a regular hem or border; at the central portions of the tail, it gradually widens and makes a short rounded projection. It is difficult to say, whether the whole caudal membrane is entirely perfect in our specimen, for there appears to be an acute point in the rock, formed by some animal remain, just beyond the rounded end of the tail. If this be a part of the animal, then the central portion of the caudal membrane is acute, and not rounded.

I am indebted to Dr. J. Trimble, of Huntingdon County, for this species. This gentleman has contributed very much to the illustration of the geology and natural history of the interesting County in which he resides, and I take pleasure in calling this species by his name. It was found by him not far from his residence, in a buff-colored clay slate. I have examined a fine large fragment of what seemed to be our present species, in the possession of Professor Oliver P. Hubbard, of Dartmouth College; but as the membranaceous expansion, if it possessed one, is broken off all round the body, we could not fully determine the question. It also occurs in yellowish limestone, and was found, in company with the Calymene *Blumenbachii*, at Juliet, in the State of Illinois.

The Asaphus *Trimblii* resembles, in some respects, the A. *laticostatus*, but its depressed form, its narrow membranaceous border, and the regular breadth of its costal arches, with some other peculiarities, will on comparison, readily distinguish the two species. The

A. *laticostatus* occurs in the ferruginous sandstone, so common in Ulster County, in the State of New York; and the A. *Trimblii* is mineralized in the yellow slate, which probably forms one of the layers of the olive slate stratum, so abundant in Huntingdon County, Pennsylvania. Dr. James Trimble has presented me with some very fine fragments of the Calymene Bufo, found by him in this locality. The reticulated structure of the oculiferous protuberances in some of them, appear as perfect, perhaps, as if the animal were in a living state.

Art. XIX.—*Remarks on the supposed connexion of the Gulf Stream with opposite currents, on the coast of the United States;* by William C. Redfield, Corresponding Member of the U. S. Naval Lyceum.

From the Naval Magazine.

It appears from numerous observations which are recorded in the American Coast Pilot, that immediately contiguous to the borders of the Gulf Stream on the North American coast, a moderate current is generally found setting to the southward and westward, or in the direction which is opposite to the stream, and parallel to the general line of coast. By a natural and familiar association, this current is generally styled *an eddy current;* but we shall probably find, on more particular inquiry, that it has little or no claim to this character. An eddy, as is well known, is usually caused by some fixed obstacle opposed to a stream, and is strictly local, and nearly circular in its action. Moreover, it derives its waters directly from the parent stream, and necessarily partakes of the same temperature. For the following reasons, therefore, I must dissent from the views of those who refer this counter-current to the eddying action of the Gulf Stream.

1. Because this current, in open sea, no where assumes the *form* of an eddy, but, when unobstructed by violent winds, maintains its course towards the southwest, on a line which is parallel to the general direction of the coast.

2. Because, on the outward edge of the Gulf Stream at least, there are no obstacles presented which could divert the progress of that portion of the stream, and circumscribe the same in eddies.

3. Because, if this current were derived from the Gulf Stream, it must necessarily partake of its temperature; but the sudden reduc-

tion of temperature on leaving the margin of the stream is most remarkable, and is almost unparalleled except in the immediate vicinity of ice.

We shall in vain attempt to explain this extraordinary change of temperature by the proximity of shallows or soundings, for this cannot avail if the water itself be derived from the gulf current, to say nothing here of the general unsoundness of this explanation.

I have long since become satisfied that the current in question is neither more nor less than a direct continuation of the polar or Labrador current, which bears to the southward the great stream of drift ice from Davis' strait, and which, in its progress to the lower latitudes, is kept in constant proximity to the American coast by the dynamical law or influence which, in the northern hemisphere, causes all currents which pass in a southerly direction to incline towards the west, in consequence of the increasing rotative motion of the earth's crust in the opposite direction, as in the case of the trade-winds in the lower latitudes.

In collating the observations of various navigators which have been published, we find reason to conclude that, in ordinary states of weather, this current may be traced from the coast of Newfoundland to Cape Hatteras, and perhaps to Florida, the reflux influence which follows a violent gale being of but short duration.

According to this view of the case, the Gulf Stream, in its course from Florida to the Bank of Newfoundland, is for the most part imbedded or stratified upon a current which is setting in the opposite direction in its progress from the polar regions. The impulses by which these diverse currents are maintained being, however, as permanent and unchanging as the diurnal rotation of our planet, their opposite courses on this coast while in contact with each other, are no more surprising or inexplicable than the case of two opposite currents of the atmosphere, and the latter are often known to maintain opposite courses for a long period, and at high velocities, while thus superimposed one upon the other.

From the fact that these great currents have their origin, one in the tropical and the other in the polar seas, their presence can be unfailingly identified by means of the thermometer; and with the aid of good chronometers their position and extent may be determined with greater certainty than has yet been done, particularly in the latitudes between Nantucket and Florida. In this department of hydrology, every navigator may contribute something of value to his profession and to science, for which no other qualifications are required than frequent observations, and proper attention to the ship's place. It is desirable, therefore, that every ship-master who traverses this region should make and record his observations hourly upon these currents.

The drift ice from the polar basin is always found in the western portion of the North Atlantic Ocean, notwithstanding the influence of violent westerly winds. A writer in the London Nautical Magazine* supposes that a portion of the polar current which bears the ice along the eastern edge of the Grand Bank into the Atlantic, there becomes exhausted, or joins the Florida stream. And in the Encyclopedia of Geography,† it is stated that the waters in the Northern Ocean, in the space comprised between Greenland and the coasts of Britain and Norway, and between Labrador and Spitzbergen, are supposed to perform a perpetual circuit; and that, being returned to Newfoundland, they recommence their revolution.

It is doubtless true that the great stream of ice is brought by the Labrador current within the dissolving influence of the Gulf Stream; and I may here remark that it is not improbable that the Grand Bank owes its origin to the deposits which have resulted from this process during a long course of ages.‡ But the polar current probably

---

* Nautical Magazine for March, 1837, p. 139. In this article it is stated that between 42° and 43° west, is the farthest easterly position in which floating masses of ice have usually been found.

† Phil. Edition, 1, p. 196.

‡ It is not intended by this remark to express any doubt of the well supported theories of elevation which are maintained by modern geologists. That large masses or blocks as well as smaller fragments and masses of earth, are removed from the rocky cliffs of the northern regions by the icebergs, and transported by these floating masses upon the bosom of the ocean, is a fact which has frequently been noted by scientific navigators and goes far in support of the above suggestion.

To the writer it appears that the remarkable transfer of blocks and boulders from northern rocks to more southern positions which is so universally observed in the United States, and in the northern countries of Europe, may with great probability be attributed to the transporting effect of ice aided by the polar currents, during the long period when these countries were in a state of total or partial submersion. A block pertaining to the feldspathic formation of the Blue Mountains west of Lake Champlain and weighing perhaps fifty tons, is found on the west side of the Hudson at Cocksackie, about one hundred and twenty miles south of the original position. Smaller fragments of the same rock have also been noticed by Lieut. Mather in his geological report as being found in Orange County N. Y., and the writer is informed that they are even found in the state of New Jersey, near two hundred and fifty miles from their place of origin.

Mr. Lyell has fully recognized this mode of natural transportation, and shows that it is adequate to produce very extensive results. He shows also that icebergs "joins" the Florida stream in no other manner than by passing underneath the same, or yielding it a passage upon its bosom, the order of superposition being mainly determined by the great diversity of temperature. The icebergs being thus carried southward by the deeper polar current, even after the latter has lost its influence at the surface, their dissolution is speedily effected by the tepid water of the Gulf Stream, and we are thus relieved from these dangerous obstructions, which would otherwise be found in lower latitudes of the Atlantic. These two streams of current, therefore, neither meet nor coalesce in any proper sense; but like other currents, both atmospheric and aqueous, pursue each its determinate course, the Gulf Stream being thrown eastward by the greater rotative velocity which it acquires in latitudes nearer the equator; and the polar current being thrown westward along the shoals and soundings of the American continent and its contiguous ocean depths, by the more tardy rotation which it derived in higher latitudes.

The writer in the Nautical Magazine above alluded to, supposes the natural course of the polar current from Davis' Strait to be towards the coast of Morocco, in North Africa; but a little attention to the effect of the earth's rotation on this current, will show that both it and the ice-drifts which are borne on its surface, must tend westwardly as above described, in despite of the powerful westerly gales which prevail in these latitudes. Light articles, however, such as bottles which are set afloat to determine the drift of currents, will not only yield greatly to the influence of these winds, but on falling into the surface current of the Gulf Stream will of course accompany this current in its progress towards the coasts of Europe, where a leading branch of this stream is found sweeping along the coast of Norway towards the recesses of the Polar Sea, and which appears to be ultimately resolved into the Labrador current. The southeasterly branch of the stream, on leaving the Grand Bank, yields to the centrifugal influence of the earth's rotation and consequently assumes the shorter and more direct circuit of gravitation by the coast of North Africa to the tropical latitudes, from whence it again merges in the Florida stream. It is by this system of compensation, aided by various subordinate gyrations, such for instance as Rennell's cur-

are met with in the southern ocean in a lower latitude than that of Philadelphia. But geologists do not seem to be fully aware of the permanent character and extent of the great polar currents, which, under successive changes of location, must have prevailed from the beginning, in both hemispheres.

rent, that the great mechanical system of oceanic circulation is apparently maintained, and which, with the operation of like causes in the atmosphere, may be supposed to have a powerful influence upon the climate of western Europe. Were the influence of winds wholly unfelt upon the ocean, it is probable that the same system would continue to be maintained, in all its essential features, by the mechanical influences of the earth's rotation combined with an unstable state of equilibrium. The energy of this rotative influence, by which the earth is flattened about twenty seven miles in its polar diameter, and the depressive force of which, in each polar basin, is equal to that of a column of mercury more than five thousand feet in height, is at least sufficient to maintain the existing movements and mechanical relations of the terrestrial fluids, under the various and continued oscillations to which these fluids are necessarily subjected.

One fact, too important to be omitted here, will serve to demonstrate the course and identity of the great ice-current for more than half the distance from Cape Race in Newfoundland to the coast of Massachusetts. On the 7th of July, 1836, H. M. packet Express passed between two large ice islands to the southward of Nova Scotia, in lat. 43° 13′ N. lon. 61° 17′ W., temperature of the water 42 degrees, depth 45 fathoms; the most western of these icebergs being in lat. 43° 09′, lon. 61° 26′, or about 75 miles southwesterly from Sable Island.

From the temperature of the sea upon the North American banks and soundings, and in some other positions which are deemed analogous, it has been assumed that the mean temperature of the sea is lower on shoals than in deep water, but it seems difficult to account for such a result, unless upon the ground already mentioned. It has, indeed, been ascribed to radiation from the bottom; and again, it has been denied that radiation from a non-luminous body can be carried on freely through the water, and as the colder particles have no tendency to rise towards the surface, it does not appear how the supposed reduction in the temperature of the bottom can materially affect a current of fifty or twenty fathoms in depth, which is derived from a foreign source; for on none of these shoals or soundings, is the water permanently quiescent. Were it otherwise, we might reasonably expect a diminution of temperature on shoals in winter, and an increase in summer, with a permanent increase, if in tropical latitudes. I am informed by George W. Blunt, Esq., who has made a course of regular thermometrical observations while crossing the Atlantic, that on entering upon soundings in the English Channel, he has found an increase of temperature in the water of 2° Fahrenheit. Those who differ from our views in regard to these currents, ought, therefore, to propose some hypothesis which will account for the extraordinarily low temperature of the waters which lave the Atlantic coast of the United States. Were these waters derived as an eddy current from the Gulf Stream, it is probable that they would no longer serve for the myriads of codfish which now frequent our shores, and which appear to inhabit the coldest waters.

Many experiments upon the drift of currents have been made with bottles containing memoranda of the date and locality in which they were committed to the sea. These experiments are not without their value, although it is obvious that a circuitous course is liable to be construed into a direct one, and that violent winds may greatly affect the course of such objects upon the surface of the ocean, while an important diversion may also result from a superficial cross current, as we have already noticed in the case of the Gulf Stream. Perhaps the suspension of some suitable weight to these floating messengers, with a line from five to twenty fathoms in length, would afford results of a more satisfactory character; although the duration of such pendulous fixtures can hardly be relied on. If fitted in this manner, the fact should be noted upon the memorandum inclosed, which should specify also the length of line which may be attached.

A full knowledge of the general system of currents in every ocean is obviously of great value to the nautical profession, and is important, also in its relations to physical science. It is hoped, therefore, that these considerations will prove sufficient to stimulate our navigators to make and record the necessary observations, and to promulgate the same through the proper channels of information.

Art. XX.—*On the use of the Dynamic Multiplier,* with a new accompanying apparatus*; by C. G. Page, M. D.

The multiplier used in these investigations is composed of three hundred and twenty feet of copper ribbon, one inch wide, wound

* As the instrument in its generalized form as described in a previous No. of this Journal, has become a very useful piece of apparatus, it is proper it should have a name. As the phenomena exhibited by this instrument belong to the class called Electro-dynamic, by Ampere, I have selected the term Dynamic Multiplier.

into a flat spiral with a single strip of varnished cotton to insulate the coils. It has ten mercury cups soldered at various distances from the center. It must be premised, that in using large batteries with this coil, the maximum results by the induced current, are obtained by including only a portion of the coil' in the direct circuit. With small pairs of plates the whole coil should be used.

A small pair of plates connected with this multiplier, deflects a delicate needle at ten feet distance.

Twelve pairs of plates arranged as an alternating series produce far more powerful results, than the same elements arranged as a calorimotor. The direct current is slightly augmented by passing through the coil. When the circuit is broken with a blunt pencil of zinc or lead, the spark appears of the size of a large pea, with a very loud snap. When both the connexions with the coil are broken simultaneously, two equally bright sparks are produced, while a third spark occurs in the induced circuit. Fifty pairs of plates give no brighter spark than twelve, and three hundred not so bright. Charcoal points, in the induced circuit, give a vivid spark, provided they do not quite touch. If directly in contact, the action of the coil is nearly lost as the current passes directly through the charcoal. This shows the reason why the induced current is stronger, when half or more of the coil is included in the direct circuit, than when the whole is used; in the latter case the lateral circuit is so short, that the battery is partly discharged through it.

It is not impossible that the arch of light may be produced in the induced circuit, if the rupture of the direct circuit could be made commensurate with the velocity of the current.

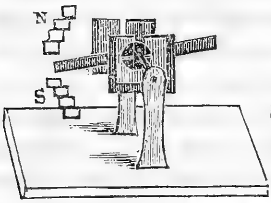
To effect decomposition, it is desirable that the circuit should be broken with great rapidity. To attain this I have tried a variety of means and succeeded in the contrivance of several beautiful pieces of apparatus.

Barlow's spur wheel answers very well where large batteries are used, but not for small. A stellated wheel, connected by a band with a multiplying wheel, answers exceedingly well; but as independence of action is a great beauty and convenience in experiments, it must give place to the following self regulating instruments.

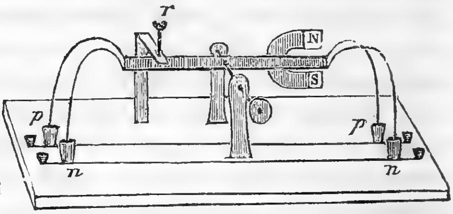
Ritchie's revolving voltaic-magnet, which has recently come to us in connection with Daniell's and Mullen's constant batteries, makes a good interruptor. Fitted with a glass cell for the mercury, made by sections of tubes, it becomes a pleasing and useful apparatus. Placed upon the box containing the multiplier, it turns rapidly without the magnets, merely by the action of the coil. The pieces of wood separating the mercury floods, or poles of the battery, should be arranged in the direction of the radius of the coil, as that is the position of equilibrium for the magnet. The opposite poles of a magnet, conspiring with the action of the coil, make the revolution extremely rapid. The interruption occurs twice in each revolution, but it may be made more frequent if the number of partitions in the cells be increased, and the magnetic poles in like manner. This instrument is liable to one objection. The mercury is often dragged across the partitions and the revolution ceases. This may in part be obviated by pouring a little water upon its surface.

Fig, 1, is a representation of a vibrating interruptor of my own invention. A piece of soft iron wire one eighth of an inch in diameter, and three inches long, is covered with copper wire, and made to vibrate rapidly between the poles of a horse shoe magnet. It should be carefully suspended and well balanced. Its motion is increased if the poles just touch the wires, to give the bar a spring. The cups for mercury (*p* and *n*) are sections of glass tubes; *r* is a thumb screw for regulating the vibrations of the bar. If the four ends of the wires be carefully adjusted near the surface of the mercury, by bringing down the screw upon the bar, the vibrations may be rendered inconceivably rapid.

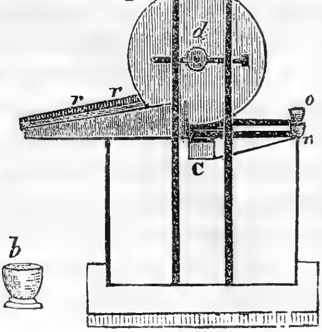
3



1



4



2

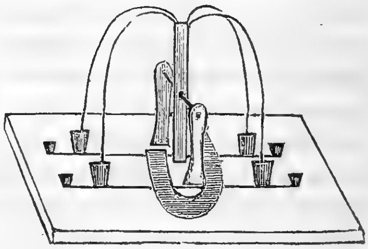


Fig. 2, is an oscillating interruptor differing from the last only in the mode of suspension.

There are two ways of arranging the wires, so as to produce motion by changing the direction of the current. A single wire may be used having two extra ends, which are to be carried to the other extremity of the bar and crossed before reaching the cups. In the oscillating interruptor the extra ends are soldered to the ends of the wire, at the same extremity of the bar, viz. the top. The other method is to cover the bar with two wires running in different directions.

Fig. 3, is a side view of a revolving interruptor, which is to be preferred to all other forms.

The bar may be of larger size and have a brass rim attached to it, to make its motions more regular; two bars at right angles may be used to increase its speed, but one will be found sufficient. The extremities of the wires are brought down upon the axis, and soldered to upper and lower pieces of copper, which are segments of circles, for dipping into the glass cells for mercury. Single wires will answer. There are three methods of changing the direction of the current. First, by using two coils of wire running in different directions; 2d, by using a single coil and having four mercury cells, two positive and two negative, and lastly, by having a single coil and two cells; the extra ends are attached, and crossed on the axis. I have tried all these methods, and prefer the last. A single horse shoe magnet held any where near the extremity of the bar, will keep it in rapid revolution. The most proper disposition of the magnets would be in a circle, having all the poles of one kind in the upper, and all of the opposite kind in the lower half. The revolution is so rapid as to scatter the mercury, if the cells are not sufficiently deep: they are made each of four strips of window glass, having sufficient space between them at the center to allow the axis to pass. The tops of the cells are then covered, and the spaces between the glass strips closed, except where the axis passes. (The mercury is rapidly oxidized, but the oxide may be saved (as it should be in all cases) and dissolved in nitric acid, for use in small batteries. The nitrate of mercury is far superior, as a motor of electricity, to acids or the cupreous salts. A single pair of plates, the size of a cent, each separated by a strip of gold beater's skin, immersed in the nitrate of mercury, give results by the dynamic multiplier, equivalent to a battery of four square feet of common construction. If the zinc plate be entirely protected by gold beater's skin, the whole of the mercury may be recovered by precipitation on the copper plate in its metallic form. Pairs of plates of copper and iron, copper and lead, lead and zinc, or iron and zinc may be used, but copper and zinc are preferable.) As a still further improvement in the revolving interruptor, I have attached a short shaft to its axis, which carries two wheels, one entire and one stellated. A small battery is used to move the interruptor, while the circuit of the battery used with the coil is broken by the star wheel of the attached shaft; the entire wheel turning in mercury preserves the connexion. The velocity of this interruptor is very great, and when viewed in the night by its own light, the whole apparatus appears to be at rest. When decompositions are performed with the multiplier and interruptors, the acidulated water is put in a glass tube, with platinum wires passing in at the ends and running parallel to each other for an inch or two, and about one fourth of an inch apart. A fine tube passes through one of the corks to allow the water to escape. Fine wires answer better than large.

On the thermo-electric spark and shock.—The six outer circles of the dynamic multiplier, connected with a single thermo-electric pair, give a bright spark, when the circuit is broken with a clean pencil of zinc or lead. The snap is very audible, and the shock distinct, by acupuncture.

Ignition of anthracite coal by the deflagrator.—Anthracite becomes a good conductor when heated, and becomes intensely ignited between the poles of the deflagrator, if the following method be adopted. Pencils of the coal being attached to the poles, the ends of a piece of copper wire bent in the form of the letter U are placed on either side just where the coal is in contact with the poles; the wires are then slowly approximated on the coal points, which soon glow with a brilliant white light, and afford a short arch.

On the use of the metals as substitutes for copper in batteries excited by the cupreous salts.—As the copper plate serves only for a conductor of the electricity put in motion, any metal having the same electrical relation to zinc as copper, must be an equivalent, provided its conducting power be as good; but where plates of metal of no great length are used, this difference must be inappreciable. The activity of such batteries is commensurate with the decomposition of the metallic salt; and as iron or lead precipitates metallic copper from its solutions, the decomposition in the batteries might be facilitated by the introduction of these metals. As the results of a number of experiments, I conclude, that iron when clean and freshly immersed in sulphate or nitrate of copper with zinc, is as good as copper. But its liability to oxidation is an objection to its use. Lead answers very well. I have batteries which were made of lead and zinc plates nearly two months since, and have used them often. Their power seems to improve by use. The lead plate becomes covered with metallic copper on the side towards the zinc. Lead plates excited by sulphate of copper, will answer for compound batteries. Mercury answers as well as copper. Bismuth and antimony, also make a good series with zinc. Brass is nearly equivalent to copper. Zinc with zinc makes a tolerable battery, provided one of the plates much exceeds the other in surface. The plate answering for a conductor, should be cut so as to leave narrow parallel strips. Other metals have not been tried. A very active arrangement is made by the nitrate of mercury and suphate of copper, separated in a cell by a strip of membrane; the connexion is made by two strips of copper immersed in each cell.

In copper or lead batteries, where the salts of copper are used, the zinc plate should be movable, in order to clear it from the copious deposit. To effect such an arrangement, and to give the battery at all times the benefit of fresh immersion, I have contrived a revolving plate battery.

Fig. 4, represents a side view of the revolving plate battery. The zinc plate is raised from the box lined with lead or copper holding the solution of the sulphate. The plate is of thick cast zinc, a foot in diameter: *d*, is a copper disc attached to the axis of the zinc plate, and when the plate is lowered, turns in a narrow mercury cell, C, fixed to the side of the box, and connected by a strip of metal with the mercury thimble, *n*: *r*, *r*, are two deeply grooved, inclined rubbers on each side, to strip and lead off into the bowl *b*, the deposit from the zinc plate. That side of the rubber which presses against the zinc plate, is covered with leather, and the pressure is regulated by springs. After the zinc wheel has been immersed a minute or two, it is turned over by its crank, which is on the side opposite the copper disc, *d*. This battery combines the following advantages, viz. the zinc plate and exciting liquid are kept clean, both surfaces are opposed to the copper or lead plate, the conducting plate exceeds the other in surface, the zinc plate will last a great length of time, if properly turned, as only half of it is immersed at once, and above all, if the zinc wheel turn accurately, it may come very near the conducting plate; whereas in batteries where the zinc plates are permanent, considerable distance must be preserved, on account of the filling up of the intervening space by deposit. A vast amount of electricity is lost, by this necessary defect in common batteries. The battery I have, has a lead cell, and can be depended upon at all times, for a regular and powerful current. Any number of parallel plates may be mounted upon the same axis, and be used as a simple or compound battery.

When the battery is not in use, the zinc wheel is raised and supported between the upright pillars, by two cross bars.

Salem, Mass. April 19th, 1837.

P. S. In my communication a few days since, I omitted to mention the form of constant or protected battery, of which I sent you a model. The truth is, it does not answer my expectations. When first used, it was active and serviceable from its economy, but time has proved it to be inferior to that of Mullen. As however I have tried a great variety of forms, with a view of determining the best, a few remarks may prove acceptable.

On the use of protected batteries.—That which is known as Mullen's, where the copper cylinder is surrounded with membrane, containing sulphate of copper, and the zinc plate outside, immersed in some alkaline salt, appears to be the most active form of protected batteries. But this battery is somewhat simplified, if the zinc plate be protected in the same manner as the copper plate, and the copper be made a tight cylinder, holding the sulphate. A considerable saving is made, if the surface of the zinc plate not opposed to the copper, be varnished or painted. The most active arrangement yet tried, is made by using the nitrate of mercury as a substitute for the salts of copper. The power of such a battery is so great, that the size may be very much diminished for common experiments. Cylinders of copper, two inches high, and an inch and a half in diameter, are sufficiently large. The arrangement is the same as in Mullen's battery, with a few exceptions; the outer surface of the zinc cylinder is varnished or painted, and likewise the inner surface of the copper cylinder; this last condition it is very necessary to observe. A little battery of this description has been immersed without being replenished seventy two hours, without any perceptible diminution of action. The solutions used, are nitrate of mercury in the copper cylinder, and nitrate of potash for the zinc. The great superiority of this battery over the sulphate of copper batteries, is due to the co-operation of an independent chemical or electrical action, viz. the decomposition of the metallic salt by the copper plate itself.

Salem, April 24th, 1837.

Art. XXI.—*Description of the Skull of the Guadaloupe Fossil Human Skeleton;* by James Moultrie, M. D., Professor of Physiology in the Medical College of the State of South Carolina: *with introductory remarks;* by C. U. Shepard, M. D.

My attention was called during the last winter to some portions of a human fossil in the museum of the Literary and Philosophical Society of South Carolina by Mr. John D. Legare, by whom I was informed that they were brought from Gaudaloupe and were undoubted parts of the much valued skeleton in the British Museum, of which so faithful a description was given by Mr. König in the Philosophical Transactions for 1814, vol. civ. p. 101. Having received from Mr. König many years since a sample of the block in which the skeleton was imbedded, I was able on the first inspection to satisfy myself, that a perfect identity subsisted between the engaging rock in both instances; and on recurring to the paper of Mr. König, it appeared that the portions here existing are among those in which the British sample is deficient, viz. the cranial bones and the lower part of a thigh bone. It struck me as being an important inquiry to ascertain if possible from an examination of the shape of the skull, whether the received opinion respecting the Carib origin of the individual were correct; for although the determination of this point, is not likely to carry back the antiquity of the specimen to a very remote period, in opposition to the manifestly recent mineral character of the rock in which it is found, still the result may give it a more ancient date than has been attributed to it, and possibly throw important light on the connection of American races heretofore considered as distinct. I accordingly desired my colleagues, Dr. Moultrie and Dr. Holbrook, to bestow upon the skull a careful examination, with which request they were very ready to comply. The result as drawn up for publication by the former gentleman, constitutes the following paper. C. U. Shepard.

Charleston, May 30th, 1837.

These precious remains, were brought from Guadaloupe by Mons. L'Herminière, a naturalist, and placed (together with many other specimens relating to natural history,) in the museum of the Literary and Philosophical Society of South Carolina in August 1816, from whom it was purchased, (in common with his collection) the succeeding November. They consist of five fragments of different sizes. The largest, is composed of portions of the temporal, parietal, frontal, sphenoidal, and inferior maxillary bones of the right side of the cranium. Saving part of the parietal near the anterior superior angle, the fragment is externally encrusted with the rough calcareous matter in which it was imbedded; while its internal surface being smooth enables us to trace upon it several important distinctive impressions. The temporal portion of this fragment is constituted of the whole of the squamous portion, the greater part of the petrous, and part also of the mastoid. On the first, appears the fossa for accommodating the middle lobe of the brain, marked by its convolutions, and the groove of the middle artery of the dura mater; on the second, the two surfaces, divided by the tentorial ridge, in the anterior of which is the hiatus of Fallopius, and in the posterior, the internal meatus, beyond which the bone is abruptly destroyed; and on the third, the deep, large fossa of the lateral sinus. This portion of the bone also exhibits impressions of the convolutions of the brain; on the lower surface, in like manner appears, the jugular fossa. The parietal bone is defective at its superior posterior part; and the external incrustation is wanting as low down as the parietal protuberance. The bony surface is rendered smooth by the removal of the deposit, exactly where it lies in apposition with this surface. Its internal face shows the marks of the cerebral convolutions, and the arborescent arrangement of the artery before mentioned. The diploic structure and tables of this bone are quite manifest at its irregular edges. The remaining frontal fragments are, the external angle and a small part of the orbitar plate —that part of it which is united to the apophysis of Ingrassias. The convoluted phenomena are somewhat apparent here also, and there are faint traces even of the coronal suture. The sphenoidal portion is apparently constituted of a small part of the greater wing, the cerebral surface of which alone is seen in the interstice formed by the temporal, frontal, and parietal divisions, composing the middle fossa. Towards the under side, imbedded within the calcareous crust, are two spots of cancellated appearance, which are probably the remains of the pterygoid process, and the alveolar edge of the superior maxillary bone which is in immediate contact with it.

The next in size is the occipital portion; the right half, separated from the left, by a vertical section passing through the middle of the bone. It is covered externally with the common crust, but is designated interiorly by the crucial ridge, part of the occipital foramen, the depressions of the lateral sinus, and the fossæ of the posterior lobe of the cerebrum, and of the cerebellum. Near the outer side of the occipital foramen, is the curved fossa of the lateral sinus, usually found just where that conduit is about to emerge from the cavity of the cranium. The diploic structure and tables are here also quite obvious at the vertical edge of the fragment.

Next, is the portion which may be taken for either a parietal or frontal fragment. I think it the latter, because, internally, it wants the arborescent features characterizing the lower half of the parietal bone, and is equally deficient in traces of the fossa of the longitudinal sinus declaratory of the upper; and with respect to uniformity of smoothness, and configuration, corresponds more closely with this bone than with the other.

The next is undoubtedly the mental portion of the inferior maxilla. This is indicated by its thickness, curvilinear figure, and the character of the alveolar processes and sockets; by the triangular tubercle at the bottom of the symphisis in front; and the mental tubercle and lateral fossa of the right digastric muscle behind; besides that the alveolar edge is sharp; the sockets, which are six in number, are single; and what is considered to be the base exhibits, very evidently, the usual close cellular conformation.

The last is obviously a part of the superior posterior angle of the parietal portion. It is the smallest fragment, and needs no particular description.

These relics have been supposed to belong to the head of an individual of the Carib race. This is undoubtedly a mistake. The anterior posterior diameter is too short, the occipital region too flat, and the lateral and vertical developments too full, upon a reconstruction of the cranium, to justify such a supposition. The following are the admeasurements, made jointly by Prof. Holbrook and myself. From the posterior edge of the occipital foramen to the concavity of the frontal bone behind the frontal sinus, five inches. From the same to the anterior superior angle of parietal bone, four inches and eight tenths. From the fossa of Sylvius to the same point, four inches and a half. From the center of the petrous ridge to the center of the cerebellar fossa, one inch and five tenths; and from the same center to the cerebral fossa, or the fossa of the posterior lobe of the cerebrum, two inches and one tenth. Compared with the cranium of a Peruvian, presented to Prof. Holbrook by Dr. Morton, in the museum of the Medical College of the state of South Carolina, the craniological similarity manifested between them is too striking to permit us to question their national identity. There is in both, the same coronal elevation, occipital compression, lateral protuberance accompanied with the frontal depression, which marks the American variety in general. Insomuch that were it possible to exfoliate, if I may so say, the fossil relics from their incrustation, the vacancies might be filled with the corresponding parts taken from the head of the Peruvian. Placing the maxillary fragment in apposition to the corresponding opposite alveolar row of this head, the physiognomy is such as to lead the imagination to view it as a fac simile of the original. JAMES MOULTRIE.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Annual Report of the Curators of the Boston Society of Natural History.*—Read at the Annual Meeting, May 1st, 1837; by D. HUMPHREYS STORER, M. D.

Your committee to whose duty it has fallen to report upon the state of the cabinet, takes great pleasure in congratulating the society upon its unprecedented prosperity. At no previous period have so many additions been made to our collections; or so much labor been bestowed by the curators upon their respective departments. Our hall has become a favorite resort for the community at large, and the naturalist finds here rich materials for study and improvement.

The number of donations the past year is one hundred and sixty, the number of donors one hundred; of these, we cannot refrain from mentioning the names of Mrs. A. A. Shattuck and Mrs. Thomas Say, and those of Messrs. Amos Lawrence, B. D. Greene, S. A. Eliott, David Eckley, Geo. B. Emerson, G. C. Shattuck, G. C. Shattuck, Jr. Wm. Ingalls, George Parkman, Charles Amory, Professor Hitchcock, Horace Gray, James Jackson, Francis C. Gray, Jonathan Phillips, John Randall, David Henshaw, J. J. Dixwell and J. B. Higginson.

The principal donations to the several departments, are as follows:

In Mineralogy and Geology.—A beautiful specimen of opalized wood from Hobartstown, S. S. Volcanic specimens from Fayal and stalactites from Ohio; but far more interesting than these, several original specimens, together with a series of casts, of the newly discovered ornithichnites or bird tracks of Professor Hitchcock, have been added to our cabinet.

The members of the society are well aware why so little attention has been paid to enriching this portion of our collections. All the cases appropriated to mineralogy, are filled with the valuable deposit of Dr. C. T. Jackson. It is however very desirable that the cabinet strictly belonging to the society, should be enlarged, that we may be prepared to supply the vacancy which would be produced by the removal of the collection before us.

Botany.—Although no addition of importance to the botanical department has been made during the last year, save a suit of plants collected in the neighborhood of Savannah, and presented by Mrs. Thomas Say, perhaps no portion of our collection has received more attention, or is becoming more rapidly, and at the same time, more thoroughly arranged, than this.

ZOOLOGY.—1. *Mazology.*—Previous to the last annual meeting, the body of an elephant weighing upwards of six tons was purchased by the subscription of several of our members. The time and labor required to prepare it for exhibition, prevented its addition to our collection many months since. Several gentlemen assisted in the dissection of the body; to our cabinet keeper alone, however, we are indebted for the completion of the perfect skeleton which ornaments our hall.

2. *Ornithology.*—The exceedingly curious and rare nest of the Ploceus Phillipensis; the eggs of a few of our birds; and a valuable collection of birds' skins, from India, from J. J. Dixwell, Esq. to whom the society have been previously greatly indebted, are the principal additions to our ornithological department. This portion of our collection now contains several hundred species, of carefully preserved valuable foreign birds. But we are compelled to add, in the *species of our own state*, the deficiency is very great. Singular as it may appear, that department of our natural history, the means of acquiring a knowledge of which are most ample, and within the reach of all; whose objects are most generally known, and all of which have been accurately and scientifically described, which are interesting not merely to the naturalist, but claiming alike the attention and admiration of the cursory observer, this department which might be made most beautiful, and as its species can *each* be procured, most valuable, has been unpardonably neglected.

Less than three hundred species of birds are found in Massachusetts. A specimen of each species might be procured and mounted for three or four hundred dollars, and yet there are our cases, empty.

3. *Herpetology.*—Several species of serpentia from Brazil, and Mississippi, and a choice collection of reptiles from India, have been added to the herpetological cabinet.

4. *Ichthyology.*—With the exception of a beautiful specimen of Lepisosteus from the Ohio river, presented by Dr. Emerson of Illinois, no additions, save a few of our own fishes, have been made to the collection of ichthyology. It would ill become your curator of the departments of ichthyology and herpetology to dwell upon this portion of his report: justice to himself however, requires he should remark in passing, that the pledge referred to by the gentleman who offered the last annual report, has been redeemed, and the reptiles, as well as the fishes, are scientifically arranged, labelled and catalogued.

5. *Entomology.*—To no department can we point with more pleasure or pride, than to that of our entomology. Each succeeding year has added new treasures to the cabinet, until it has become by far the most extensive and valuable in the United States. The following extract from an elaborate report kindly offered me by the curator of this department, will undoubtedly be gratifying to the society. "At the annual meeting in May, 1836, Dr. Gould reported the condition of the cabinet of insects, and the additions and donations which had been made to it. All the *diurnal* Lepidoptera were then arranged and named, and some progress had been made in arranging, determining and labelling the Coleoptera. About one half of the insects of this order are now finished, their names as far as they could be ascertained are affixed to them, and the species are arranged and referred to the new genera according to the catalogue of Count Dejean. The number of species now entered upon the catalogue amounts to two thousand one hundred and eighty, and when the remainder are added, the cabinet will contain at least two thousand and six hundred species of Coleoptera, without including those in the collection of Professor Hentz.

"The processes necessary to be gone through with the insects renders the work very slow and tedious. Many of the insects require to be cleaned; a large number are badly impaled, upon short, clumsy or crooked pins, and must therefore be softened so as to have these pins extracted and new ones inserted, and this delicate and hazardous process requires no little skill and patience in the execution; they are then to be determined, labelled and fixed in a box in order to be baked, an operation essential to their future preservation; and lastly they are to be placed in proper order in the drawers where they are to remain, with the names of the families and genera affixed to them.

"The drawers in which the Lepidoptera and Coleoptera are contained, I have supplied with strips of soft pithy wood to receive the pins of the insects; but having exhausted my supply, in preparing the drawers in the cabinet of the society, I have been obliged to suspend my labors until the remaining drawers shall be prepared in the same way; for experience has taught me the necessity of having the drawers lined entirely, or partially, at least, to receive the slender pins used for insects and render them safe in their places.

"The additions to the cabinet of insects during the past year consist of one box of Chinese insects, and one double box containing specimens from South America, both presented by Col Baker: nineteen specimens in spirit from Calcutta, presented by Mr. Dixwell: one hundred and fifty one specimens from the Cyclades and Marseilles, presented by Mr. Richards: one small box of specimens packed between layers of paper, collected in the island of Syra, and presented by the Rev. J. J. Robertson: and a box of Swedish Coleoptera, containing two hundred and forty one specimens from Mr. Fabræus of Gottenburg, sent for exchange through Dr. J. S. Copley Greene, in return for which, an equal number of specimens has been selected from our duplicates and sent to Mr. Fabræus.

"Mr. W. W. Wood of Manilla, from whom the society received, during the last year, three boxes of exceedingly valuable insects through the kindness of Mr. Russell, has in reply to a letter from me, offered to collect and send to us more insects from the Phillippine islands, if we will furnish him with boxes, pins and camphor; and I would recommend the society to embrace his liberal offer, and supply him with the means of executing it.

"Dr. Zimmerman, the author of a work on the Carabidæ, when here on a visit from the South, during the last summer, received from Dr. Gould and myself a large collection of the duplicates belonging to the society, in return for which he promised to send an equal number of species from the Cape of Good Hope, and other countries, the entomology of which is not yet represented in our cabinet.

"On the 18th of June, 1836, there arrived from New Orleans, the collection of Professor Hentz, sent to us in consequence of a negotiation with me for the purpose by subscription of this large and valuable collection for our society. If no mistake has been made in counting the insects there were fourteen thousand one hundred and twenty six specimens, one thousand three hundred and fifteen of which are foreign insects, leaving *twelve thousand eight hundred and eleven native insects.* Many of these are duplicates, but not the less valuable to the society on this account. They have already furnished us with specimens to return to Mr. Fabræus, in exchange for the insects received from him, and I have sent also a few of them to Mr. Schönherr for their names, and with the request that he would honor us with insects in exchange for them.

"There were several boxes and drawers in Mr. Hentz's collection very closely filled with insects of all orders promiscuously mixed together. These it was desirable should be assorted and incorporated with the others. In fact, it became absolutely necessary to select the Coleoptera without delay, to enable me to make a proper choice of specimens to be used in making exchanges. Accordingly, when obliged to suspend my labors on the cabinet of the society, for the want of drawers properly prepared to receive the insects, I began to assort the miscellaneous collection received from Mr. Hentz, and proceeded with all possible expedition until they were transferred from the boxes and drawers in which they came, to their proper places in the other part of the collection. *All the Coleoptera* received from this gentleman have been carefully examined, and are arranged in a regular series, according to the catalogue of Count Dejean. It will be comparatively an easy task hereafter to transfer these Coleoptera and unite them with the general collection of the society, should this be deemed advisable. I propose next, to arrange the insects of the other orders in a similar way."

6. *Conchology.*—Valuable accessions have been made during the past year, to our cabinet of shells. Several individuals have presented most acceptable donations.

Many specimens of foreign shells from Mr. Couthuoy—as uite of fresh water bivalves from the Ohio, from Dr. Ward of that state—and a large collection of East India shells from J. J. Dixwell, Esq. are most worthy of notice.

These additions, however, are not all which have increased the value of the collection. Much labor and study have been devoted to their classification; and although containing at the present moment 153 genera, and 1700 species, the names of 1200 species have already been ascertained.

This is the largest public collection of shells in the Union, and adds more than any other department to the attraction of our museum.

7. *Zoophytes.*—Although no very great additions have been made to the collection of Zoophytes, we should not forget to mention a very beautiful foreign scutella, presented by Dr. T. W. Harris; a large mass of sponge attached to the madrepore, upon which it grew, from the Red Sea, presented by J. A. Lowell, Esq. and a valuable collection of corals from the East Indies, presented by J. B. Higginson, Esq.

The number of species now in our entire collection is as follows.

Mineralogy and Geology.—About seven hundred specimens.

Botany.—Several thousand species of plants, besides fruits, &c.

Zoology.—*Mammalia.*—Thirty whole skeletons; among these, those of the Simia satyrus, Cebus fatuellus, Hylobates fuscus, Erinaceus Europæus, Talpa Europæa, Elephas Indicus, Rhinoceros Indicus, Tapir Americanus, Hydrochœrus capybara, Cervus elaphus, Antilope dorcas, Didelphis Virginiana, Mustela lutreola, &c. &c. Thirty crania, some of which, are those of the Felis tigris, Sus scropha, Sus babirussa, Cervus Virginianus, Equus caballus, Mephitis putorius, Canis familiaris, Felis catus, Sciurus cinereus, &c. &c. besides many beautiful horns, and antlus; those of the Cervus alces, Cervus Canadensis, Antilope furcifer, Antilope rupicapra, Antilope strepsiceros, Antilope gazella, Antilope mhorr, Antilope gnu, Bos bubalus, var. Bos arni, should not be passed by unnoticed.

Birds.—Whole number mounted, fifty six. Several hundred, not mounted.

Reptiles.—Ninety genera—one hundred and thirty species.

Insects.—About fifteen thousand species.

Shells.—Upwards of seventeen hundred species.

Crustacea.—One hundred and thirty species.

Radiata.—One hundred and ninety species.

Library.—The Library contains about 600 volumes.

The most valuable additions which have been made to it the past year, are a memoir on the Nautilus pompilius, Audubon's Ornithological Biography and a set of the original plates to Abbott's birds of Georgia, from individual members; and the magnificent plates to Audubon's Ornithology, and the invaluable works of Olivier and Voet, presented by subscription. The former of these donations, are too well known to require a single remark; of the latter works, the curator of Entomology observes in his report upon Mr. Hentz's collection, of which they made a part, "it is hardly necessary to advert to the works of Olivier and Voet, which came with the insects. They are adorned with numerous plates, engraved by the best artists of the day and beautifully colored. The work of Olivier is in 10 volumes quarto, splendidly bound in calf and gilt; that of Voet in 4 vols. quarto, is in fancy boards, but the plates are even superior to those of Olivier's work. There is in the College library an imperfect and incomplete copy of Olivier's work, with uncolored plates, and in the library of the Academy of Natural Sciences of Philadelphia both of these works are to be found. These are, as far as I know, the only ones in the country—they are rarely to be obtained in Europe, and then only at a high price and some risk to the importer."

Communications.—Besides many verbal reports of great interest, twenty four written communications have been presented the last year by the following gentlemen, on the following subjects.

C. T. Adams.—The changes produced upon Mt. Holyoke by the effects of diluvial currents.

Amos Binney.—On several new species of shells in the cabinet of the society and on the Helices of the United States.

T. M. Brewer.—On the catologue of birds in Professor Hitchcock's Report, and a review of George Ord's paper in Loudon's Magazine of Nat. History, on the habits of the Cow-bunting.

J. P. Couthuoy.—Report upon a new shell from New Holland, a new species of Marginella, and a new species of Tritonia.

E. S. Dixwell.—Upon the luminosity of the sea.

A. A. Gould.—A report upon craw fish.

T. W. Harris.—On the Biche du mer, on the nest of the Placeus Phillipensies, and on the Meadow mouse.

C. T. Jackson.—Upon the coal mine at Mansfield: upon an analysis of three species of water from the Azores.

J. B. S. Jackson.—On the anatomy of the Testudo elephantopus, and on the anatomy of the genital organs of the horse.

D. H. Storer.—A report upon the Blennius physis, on a new species of Gasterosteus, on a new species of Marginella, and on a new species of Hydrargira.

Three years since, an effort was made to establish a journal containing papers upon Natural History read at the meetings of the society; and the first number was published. Its limited circulation rendered it inexpedient that the society should be longer responsible, and the expenses of the numbers published the two succeeding years, were liberally met by two of our members. It gives us great pleasure to add, that since the last annual meeting, a sufficient number of subscribers have been procured to meet the expenses of a *fourth*, which is now in course of publication; and that in future, our journal will appear more frequently.

The *committee of publication*, confidently look to the members generally, for countenance and support: they would use their utmost endeavors to make their publication alike creditable to the society and New England. While the societies of other cities in the Union are continually adding something new to the treasures of natural science, we should not be left in the course.

Mortifying indeed it is, to look over the catalogue of the natural history of our state, and not see a single bird, or fish, or reptile, or mollusk, associated with the name of an acting member of this society. *By others, they have all been made known. Much however remains undone.* Hundreds of our plants are unknown to naturalists:—the habits of many of our birds, and reptiles and fishes, are imperfectly understood: the list of our Crustacea and Radiata remains to be greatly enlarged; of the 2300 insects catalogued in Professor Hitchcock's report, *more than* 1100 *are new;* and by whom can they be better described, than by the *author* of that catalogue?

Disappointed in having no annual address, the gentleman who drafted the report the last year, added much to its value, by making an analysis of several of the written communications which had been read at the regular meetings of the society. Although many of the papers which have been presented since then, are of peculiar interest, and to offer the substance of which, would be most grateful to the feelings of your committee, he is reminded that by pursuing this course at the present moment, the report would encroach upon his time,* who is far better able to interest and instruct you, than he who has thus cursorily glanced at the progress of the society, since our last annual meeting.

---

* Rev. Hubbard Winslow—the anniversary orator.

2. *Crosse's Galvanic Apparatus.**—The public attention having been much excited by the unpretending statements of Mr. Crosse at the late Bristol meeting, and with the remarkable effects produced by a galvanic apparatus the most extensive of any that has ever been erected, at least by a private individual, we doubt not that the following letter addressed to the editors of the London Mining Journal, by a gentleman so well known in science as the writer, (together with the article which immediately follows,) will be acceptable to the readers of our Journal.

TO THE EDITOR OF THE MINING JOURNAL.

Sir—Some questions having appeared in your recent numbers, concerning the construction of the galvanic apparatus of Mr. Crosse, I am happy in having it in my power, from having spent some interesting days in his house, to give your correspondents an account which I hope may prove satisfactory. I rejoice in the opportunity thus afforded me of showing, that although locally removed, I can never cease to feel a warm interest in what is passing in a county endeared to me by so many associations. Each separate combination, forming one of the members of Mr. Crosse's galvanic series, consisted of a plate of copper, containing from three to four square inches of surface, bent round so as to form a cylinder, inside of which was a similar plate of zinc; round the interior zinc cylinder a thin string was coiled spirally, to keep its surface, throughout, separate from that of the exterior copper cylinder—these metallic cylinders, were, in about a quarter of the series, placed in glass cylindrical vessels, just large enough to contain them, and filled with water; but, in the greater number, the external copper cylinder being soldered and closed at the bottom, so as to hold water itself, the glass containing vessel was dispensed with. When this was the case, the metallic cylinder was separated from the table on which the apparatus was placed, by the intervention of a small square of common glass, a little broader than the diameter of its base; this was done to secure the insulation. These cylinders were arranged into a series, in the usual form, by copper arches passing from the copper cylinder of each combination to the zinc cylinder of its neighbor. The apparatus when I saw it, just after the late Bristol meeting, was composed of eight hundred such cylinders, disposed in continuous lines, so arranged as to occupy the least room. Its effects, though excited with water only, were very powerful. I should say, equal to those

* From the Franklin Journal for April, 1837.

ordinarily produced by about one third of the same number of galvanic combinations of equal surface, excited by acid—considerable lengths of thin wire were fused, &c. A common electrical battery of great size, containing seventy feet of coated surface, was charged in a single instant, if connected with the wires proceeding from the extremities of the galvanic series; and when successive discharges were, under these circumstances, taken from the electrical battery, the effects were most intense. After receiving three or four such discharges on the point of my pen knife I found, on examining it with a glass that its extremity had been completely fused. I need not dwell on the extreme importance of having constructed an apparatus capable of producing such powerful effects, when excited by water only; the excitation by acid is violent at first, but goes on rapidly decreasing, and at the end of three hours becomes almost null. If it were attempted to sustain an uniform action, by the continual affusion of fresh acid, the zinc plates would be entirely corroded in a very few days; indeed, the constant attendance necessary, and the enormous expense, would render such an attempt practically impossible. But in Mr. Crosse's apparatus, though excited by water only, we have a strength equal to very large ordinary troughs, say three hundred plates, and that strength is uniform and permanent, and requires no further attendance than replenishing the water, (from the loss sustained by evaporation,) once in six weeks; in this mode also, the corrosion is so slow, that the same apparatus might probably last for twenty years; much of it has already been in constant action much more than a year, and does not seem in the least impaired. The importance of imitating nature, by keeping in constant and uniform activity such powerful galvanic currents, must be obvious. Besides the series I have described, Mr. Crosse had begun to construct one of much larger dimensions; each cylinder containing a square foot in surface. Should he proceed with equal vigor we may expect some day to hear of two thousand of such cylinders; the effects must then be almost terrific. Could we, inquisitor-like, put nature to the question, by so efficient an instrument, she could hardly resist any interrogatories we might please to put to her, and all the mysteries which at present perplex us in chemistry might be expected to stand revealed. I should regard the completion of such an apparatus as quite a national object; and I feel convinced, that it is by proceeding in this line that we may best hope to see the force of electricity practically applied as a moving power, and the energy of lightning bent, like that of steam, into subserviency to the purposes of human art. I remain, Sir, your obedient servant,

W. D. Conybeare.

3. *Accidental Production of Animal Life;* by Mr. Crosse.—A communication from Mr. Stutchbury, of the Bristol Institution, has been disseminated through the public journals, of which we give a copy. As there is no doubt of the honor and veracity of Mr. Stutchbury, the extract which this gentleman gives from a letter of Mr. Crosse, may be considered as if communicated by Mr. Crosse himself.

Sir—It may be truly said that facts recorded, faithfully detailed, and made public, are the means by which philosophy is enabled to render her temple more durable on its foundations—every additional fact being the commencement of that which, when understood, forms an outwork of defence, rendering the interior the strong hold and sacred depository of truth.

It was a maxim of the late John Hunter, which he was repeatedly proclaiming, that greater benefit would be conferred upon the community if professional men had the moral courage to publish detailed accounts of all their unsuccessful cases, than could be derived by the publication of those which met with a favorable termination, for then the physician would reject at once such as had failed as modes of cure, without repeating experiment after experiment, thereby saving much valuable time, and certainly sparing much needless pain to the unfortunate patient. So with facts in natural philosophy. Let experiments be recorded, and their results will enable others, either to avoid, or successfully to pursue them, so as to bring them to bear upon principles which may elucidate some great truth, the light of which would probably have never shone upon them, had they not been able to take advantage of the works of pioneers who had proceeded, perhaps, to the very threshhold of the same result.

With regard to a large number of curious and (at the same time, in consequence of the principle not being understood) astounding facts, the investigator would be doing a great injury in the cause in which he labors, should he be deterred from making them known, merely because he cannot at the same time reasonably account for the same. And upon this view of the subject, and to set at rest the vague views which are abroad, I feel it a duty due to the cause in which I am engaged, and to the philosopher with whom they have originated, at once to take the liberty of transmitting to the press, and particularly the local press, from which so many reports have emanated, an abstract of a letter I have received from Mr. Crosse, with an account of his experiments, in the language of a private communication, (not that which he would probably have chosen, had he made the communication himself,) and without further comment.

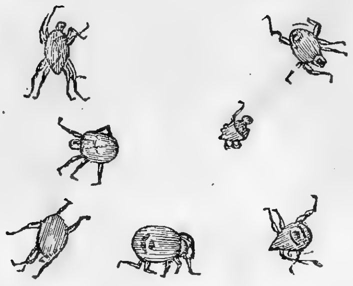
"The following is an accurate account of the experiments in which insects made their appearance:—

"*Experiment first.*—I took a dilute solution of silicate of potash, supersaturated with muriatic acid, and poured it into a quart basin, resting on a piece of mahogany; a Wedgwood funnel was placed in such a manner that a strip of flannel, wetted with the same, and acting as a siphon, conveyed the fluid, drop by drop, through the funnel upon a piece of somewhat porous Vesuvian red oxide of iron, which was thus kept constantly wetted by the solution, and across the surface of which, (by means of two platina wires connected with the opposite poles of a voltaic battery, consisting of nineteen pair of five-inch plates in cells filled with water and $\frac{1}{500}$ muriatic acid,) a constant electric current was passed. This was for the purpose of procuring crystals of silex. At the end of fourteen days I observed two or three very minute specks on the surface of the stone, white, and somewhat elevated. On the eighteenth day, fine filaments projected from each of these specks, or nipples, and the whole figure was increased in size. On the twenty-second day, each of these figures assumed a more definite form, still enlarging. On the twenty-sixth day, each assumed the form of a perfect insect, standing upright on four or five bristles which forms its tail. On the twenty-eighth day, each insect moved its legs, and in a day or two afterwards detached itself from the stone and moved at will. It so happened that the apparatus was placed fronting the south, but the window opposite was covered with a blind, as I found these little animals much disturbed when a ray of light fell on them; for out of about fifty which made their appearance at once, at least forty-five took up their habitation on the shaded side of the stone. I ought to have added, that when all the fluid, or nearly so, was drawn out of the basin, it was caught in a glass bottle, placed under a glass funnel which supported the stone, and was then returned into the basin without moving the stone. The whole was placed on a light frame made for the purpose. These insects have been seen by many of my friends, and appear, when magnified, very much like cheese-mites, but from twice to eight times the size, some with six legs, others with eight. They are covered with long bristles, and those at the tail, when highly magnified, are spiny. After they had been born some time they become amphibious, and I have seen them crawl about on a dry surface.

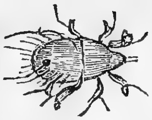
"*Experiment second.*—I took a saturated solution of silicate of potash, and filled a small glass jar with it, into which I plunged a stout iron wire, connected with the *positive* pole of a battery of twenty pair of cylinders, filled with water alone, and immersed in the same a small coil of silver wire, connected with the *negative* pole of the same battery. After some weeks' action, gelatinous silex surrounded the iron wire, and, after a longer period, the same substance filled up the coil of silver wire at the other pole, but in much less quantity. In the course of time one of these insects appeared in the silex at the negative pole, and there are at the present time not less than three well-formed precisely similar insects at the negative, and twelve at the positive pole, in all fifteen. Each of them is deeply imbedded in the gelatinous silex, the bristles of its tail alone projecting, and the average of them are from half to three quarters of an inch below the surface of the fluid.

"In this last experiment we have neither *acid*, nor *wood*, nor *flannel*, nor *volcanic iron-stone*. I will not say whether they would have been called to life without the electric agency or not. *I offer no opinion, but have merely stated certain facts.*"

In addition to this, on Friday, the 10th ult., Mr. Crosse transmitted to Mr. Owen, Hunterian Professor, College of Surgeons, London, a copy (pehaps the original) of the above, in his own hand-writing, with several specimens of the insects themselves, so enclosed in Canada balsam and between plates of glass and talc, as to be easily submitted to examination in the microscope. By the kindness of this gentleman, Mr. Clift, conservator of the museum, in the same establishment, produced them at the *Conversazione* of the Royal Institution on Friday, the 17th, when they were most satisfactorily visible in the microscope. By an extension of the same courtesy on the part of Mr. Owen, we have been permitted to draw and engrave two of the groups of these mysterious visitors, in order to gratify the prevailing intense desire for accurate information upon the subject.



The Insects magnified.



Cheese Mite, magnified to the same degree.

The insects above delineated are some of those collected and sent to London by Mr. Crosse. We have placed an ordinary cheese-mite near them, drawn to the same scale, in order to show the relative size, and the similarity of appearance. Like the mite, the new insects have fine hairs scantily distributed on the body, but these became invisible on the immersion of the insect in the balsam. Their varied positions, the arrangement of their legs, &c., are owing to their accidental suspension in the balsam, and the subsequent pressure of the plate of talc upon them.—*Mag. Pop. Sci.*

We cannot believe that life and organization have been produced by galvanic power, but would sooner suppose that the ova of the insects may have been contained in the materials galvanized or come into them during the process, and that the galvanic power may have quickened them into life, as electricity and animal warmth operate upon eggs.—Ed. Am. Jour.

4. *Fossil Remains of the Elephant*, Elephas primigeneus.—Every discovery of these fossils in our country deserves a distinct record by some responsible name. Some account of the following was published in the public papers, but I believe no notice of them is to be found in this Journal.

These fossil remains were dug up from a sand bank on the Irondiquot Creek in the town of Perinton, about ten miles east of this city.

They consist of a *tusk* and *two teeth* of the fossil elephant. The teeth are well preserved. The tusk had decayed for some distance at each end. As it lay in the sand, curved somewhat, it measured *ten* feet in length, and *seven feet* of it were removed, but a portion of this length broke into many pieces. The longest piece is *two feet* *and a half* long, and *five* inches in diameter, and as it belonged near the middle part of the tusk, the whole was of great size and near the root was probably eight inches in diameter. The large piece and many fragments are now in the possession of Mr. Butler, the enterprising proprietor of the museum in this city.

These fossils were found April 2d, 1833, in excavating the earth for the passage of water at a saw-mill. It is said that there were no indications of other bones or teeth. About *twenty* years before, a *thigh bone* of some huge animal was found in removing the earth a few rods below in the same bank. The whole probably belonged to the same animal, and more may yet be discovered on further removal of the earth. The *thigh bone* is said to be in the possession of a gentleman in an adjoining town to Perinton, but I have not been able to discover it. The tusk lay about *four feet* below the surface, and partly under the stump of a large forest tree. The place was covered with forest a few years ago; I have conversed with several individuals who were at the place, and knew the circumstances, and have examined the remains in the museum. There can be no doubt about the character of these remains and that they had been buried for centuries in the earth. The place is in the road, at the Irondiquot creek, a little distance from the place called *Fullum's Basin*, perhaps ten miles from Lake Ontario.

The *geological* relations of these fossils next merits attention. In this case there is no uncertainty. The Irondiquot creek is nearly on a level with Lake Ontario for four or five miles, and at this place, perhaps from the lake, is not more than fifty or eighty feet above it. The banks of the creek are *sand* thrown up into hillocks and sloping sides, from twenty to more than a hundred feet high; the sand being spread over a large extent of the country. The formation is evidently *diluvial*, resting on the *transition* rocks of this section. In various places the ground, coarse and fine, is mingled with this sand, and boulders of the primitive rocks brought from a region far at the north. On the surface we find the *erratic group*, in boulders of *granite*, *gneiss*, *mica slate*, *hornblende rock*, and *quartz*. These boulders are of various magnitudes. Some of them are large rocks, weighing many tons, and showing manifest evidences of the grinding power of sand and water, by which they were rounded. The Irondiquot runs nearly parallel to the Genesee, but is much lower, as the canal descends from the Genesee by several locks and then crosses the Irondiquot by the *great embankment of eighty feet* above the stream, only two miles south of the place where the bones were found. At this embankment, the sand is rolled up into still higher elevations than those already mentioned. Whenever the animal died, its bones seem to have been buried by that rushing of the waters, which accumulated these masses of sand, and left them as the miniature resemblance of the rolling waves of the mighty deep.

Rochester, N. Y., April 6th, 1837.

5. *Interlocking of Beech Trees.*—On the farm of Col. Geo. Warner in the southwest part of Stockbridge, Mass., is the following curious interlocking of two trees of the common *beech*, fagus *ferruginea*. They grew on the side of a hill near the bank of the Housatonic River, where the passage of the river around and through the north part of Monument Mt. presents very beautiful scenery. The right hand tree, *A*, as you stand facing the north, is nine and a half inches diameter at the base, while the left hand tree, *B*, which stood at the distance of eighteen inches from it and a little lower down the hill, is four and a half inches in diameter and shows *forty-four concentric layers*. The limbs of the trees are peculiarly zigzag or tortuous. At the height of ten feet from the ground, a limb from *B* has become so entangled in the limbs of *A*, that the body of *A* has grown entirely over the limb and so perfectly inclosed it that the limb appears to grow directly through it. The tree *A* is here five and a half inches in diameter, and the limb passes through it nearly in the middle from the center to the outside. The limb from *B* is two feet long to *A*, and one inch and a half in diameter where it enters *A*, but it is only one inch in diameter were it issues and then extends *ten feet*. The limb starts from *B*, about eleven feet from the ground. In the winter of 1836, the tree *B* was cut off for wood; but the farmer, finding it strongly entangled in the other tree and the weather being very cold, left it without ascertaining the reason of its being held so firmly by *A*. In the summer he saw that the tree, though cut off and having turned round from the weight above so as to have its lower end about three feet from the ground, was flourishing with rich foliage; he ascertained the singular union of the two trees, and called the attention of the curious to the fact. When I saw the trees in September last, they were covered with large, full, bright leaves, the one equally with the other so far as the eye could ascertain from laying the leaves side by side. The trunk of *B*, which was cut off, had healed over at the lower extremity so as to be green

with life quite to its end, and seemed to be as vigorous as the other. The trunk and limbs of *B* extend twenty feet beyond the limb which unites the two trees.

It is evident that it is the sap of *A*, which is elaborated in *B*, and is employed for its support. It is probable that the vessels in the part of the limb which unites the trees and in which the sap originally ascended are now used for the passage of the sap from *A* to *B*. In this case the vessels for the ascending sap perform their usual function through most of the uniting limb, and their action is inverted in the uniting part.

Rochester, N. Y., March 29, 1837.

6. *Rotting of timber in certain situations.*—Extract of a letter to the editor, from Mr. D. Tomlinson of Schenectady, N. Y., dated April 4, 1836.—In the year 1801, I built a ware-house on my lot in Union Street in Schenectady. The cellar was dug about four feet deep, and the stone wall a foot or two deeper. I left no opening in the walls for door or window. The floor beams were of excellent pitch pine timber of twelve by twelve inches, slit, and were six by twelve inches when placed in the wall, and about eighteen inches above the ground. I laid a floor of three inch oak plank, loose, neither jointed nor nailed, although they were square edge, and lay close to each other. Five years thereafter, I observed a jostling in a place in the floor, and raised one of the planks to learn the cause, and found one of the six by twelve inch beams rotted off and fallen on the bottom of the cellar. The plank was rotten below, except about an inch sound on the upper side. I lifted the whole floor, found most of the planks rotten, except a shell on the top; and the timbers were rotten, and so decayed, that I took them out and put in oak, after making windows and a door in opposite sides of the wall. I thought the depth of the cellar would have prevented injury to the timber, but found it the cause of the destruction, as fine shavings and slivers lying on the bottom of the cellar, were perfectly sound, while the timbers, were beautifully ornamented with curtains of white mold, hanging in festoons, nearly to the depth of the cellar, as white as snow, very thick, and appeared like bleached muslin.

In the year 1817, I took down an old kitchen on the same lot. The floor had lain on saplings of about 6 by 8 inches, such as are used for scaffold poles. They were bedded in the ground, so that the pine floor came next the ground, and excluded air. They had lain there from 1794, and both the timbers and flooring were very little injured by rot.

I concluded, that a free circulation of air must be allowed, or air must be entirely excluded, to save timber from decay.

It has been found, that when posts are set in the ground and cased with boards for better appearance, the confined air destroys them. Even red cedar, which lasts an age when set open, if cased, which is often done for ornament in gate posts, decays as soon as any other wood, by the confined air.

7. *The odor of wines, due to a peculiar ether.* By MM. J. Liebig and Pelouze. (Ann. de Ch. et de Phys. Oct. 1836.)—It is a fact of common observation, that a bottle containing but a few drops of wine, gives off a peculiar odor, which cannot be imitated by mixing alcohol and water in the proportions in which they exist in the wine. This characteristic odor, which is more or less apparent in all wines, is produced according to MM. Liebig and Pelouze, by a fluid possessing all the characters of an essential oil. The flower, aroma, or *bouquet of wine*, as it is more especially called, is produced by a substance which is inodorous, and should not be confounded with the subject of these remarks; it is not volatile, is different in the several kinds of wines, and in many fails entirely.

This oil may be obtained by distilling large quantities of wine, or the lees of wine, or especially from the product deposited after fermentation has commenced. From the results obtained they infer that this oil constitutes about $\frac{1}{40000}$ part of the wine. The oil as thus obtained, before purification, has a strong odor, and is generally colorless. Occasionally it presents a slightly greenish tint, derived from the presence of a small quantity of copper, as is proved by reagents; this color may be removed by distillation.

The constitution of this product, though it contains a considerable quantity of oxygen, is quite different from that of the oxygenated essential oils heretofore known. It proves to be a peculiar ether containing an acid allied to the fatty acids. This new acid is called by its discoverers, *œnanthic acid*, and the ether, consequently, *œnanthic ether*.

Œnanthic ether.—The œnanthic ether may be deprived of any free acid it may contain, by agitation with a hot solution of carbonate of soda, and subsequently boiling the mixture; the ether rises to the surface and may be readily removed. The small quantity of water or alcohol which it still retains, may be separated by means of the chlorid of calcium. The ether thus purified, is very fluid, similar to the essential oil of mustard. It is colorless, has an extremely strong odor of wine, which when respired is almost intoxicating. Its taste is very strong and disagreeable. It dissolves readily in ether and alcohol, even when the latter is quite dilute; yet it is not sensibly soluble in water. Its density is 0.862 and it is but slightly volatile. It boils between 225° and 230° C.

In three analyses, MM. Liebig and Pelouze obtained the following results,—

Carbon, . . .	71.815	72.50	72.02
Hydrogen, . .	11.844	11.86	12.05
Oxygen, . .	16.341	15.64	15.93

which correspond very nearly with the formula $C^{18} H^{36} O^{3}$. The œnanthic ether is readily decomposed by the caustic alkalies. With potassa, it affords a very soluble compound, consisting of œnanthic acid and potassa. When this salt is decomposed by sulphuric acid, the œnanthic acid forms an oily bed on the surface of the liquid.

Œnanthic acid.—This acid presents a butter-like consistence at a temperature of 13.2 C. and is of a white color; at a higher temperature it melts and forms a colorless, inodorous oil, which reddens turnsol and unites readily with the caustic alkalies and alkaline carbonates. The œnanthate of potash, is a pasty mass composed of extremely fine fibres, which present a silky lustre after desiccation. From the composition of the œnanthates of lead and silver, the authors infer that 2 atoms of base saturate 3 of acid.

In three analyses, MM. L. and P. obtained for the hydrated acid;

Carbon, . .	69.28	69.74	68.59
Hydrogen, . .	11.54	"	11.56
Oxygen, . .	19.18	"	19.85

which lead to the formula, $C^{14} H^{28} O^{3}$. The anhydrous acid afforded carbon 74.32, hydrogen 12.2, oxygen 13.58, which corresponds with the formula $C^{14} H^{26} O^{2}$. It may hence be inferred that œnanthic ether is composed of œnanthic acid united to common ether, as is represented in the formula $C^{14} H^{26} O^{2} + C^{4} H^{10} O$, in the construction of which and also in the preceding deductions, Berzelius's atomic weights have been used.

8. *Essential oil of potatoes*, by M. Augustus Cahours, (L'Institut, No. 199.)—According to Dumas, the essential oil of potatoes is represented by the formula, $C^{20} H^{24} O^{2}$. M. Cahours infers that this

oil is a compound analogous to alcohol and spirit of wood, in consisting of a peculiar compound of carbon and hydrogen for its base, ($C^{20}H^{20}$,) united to two atoms of water. He cites the following experiments by himself as proof of the correctness of this view.

The oil treated with sulphuric acid, and subjected to a mild heat, yielded an acid containing the same carburetted hydrogen for its base. This acid formed with bases soluble compounds, whose analogy with sulphovinates is incontestable. The salt of baryta, for example, contained $SO^3 BaO + SO^3, C^{20}H^{20}, H^6O^3$. If the oil is put in contact with iodine and phosphorus, an ethereal substance is disengaged, giving off a slightly alliaceous odor, which is similar in composition to hydriodic ether. With nitric acid and chlorine, it afforded products of analogous constitution.

9. *Royal Geographical Society.*—At a late meeting of the Royal Geographical Society, there was read the following Memoir.—A Memoir on the province of Omán, on the East Coast of Arabia, by Lieut. J. R. Wellsted, Indian Navy, F. R. S.

The author of this highly interesting paper,—as indeed must be the description of a country into which, as the memoir states, "no European traveler has hitherto penetrated, and whose people and country remain wholly unknown to us,"—was selected by the government at Bombay to make a journey into the interior of Omán, and, with the usual spirit of liberality shown in the Indian service, was provided with instruments of all sorts for making scientific observations, with letters to the Imám of Muskat, who, as Mr. Wellsted states, "with his characteristic liberality, in every way forwarded my views, and gave me letters to the chiefs of all the districts through which I had to pass;"—and, in short, with every facility for this enterprising journey.

Quitting Bombay, Mr. Wellsted reached Muskat on the 21st November, 1835; this city has of late years been often described, but we may notice that our author states its population, including Mattrah, to be 60,000 persons, and its imports at 3¼ millions of dollars. He thence went by sea to the port of Súr, about eighty miles to the southeast of Muskat, where he was civilly received by the Sheikh, and provided with guides and fourteen camels.

"*Dec.* 2. Leaving Súr," says Mr. Wellsted, "I journeyed along the Wadi Falij, twenty miles, in a southwest direction, towards the district of Jailan, thence S. S. W. twenty-two miles over a flat and uninteresting country, to the camp of the Beni Bú Ali Bedouins, in lat. 22° 3′ N. It was here that the detachment of troops under Captain Thomson, who, in the year 1820, in company with the army of the Imám of Muskat, had marched against this tribe, suffered so severely, and in consequence of which the following year Sir Lionel Smith was dispatched against them and destroyed them.* Since that time no European had visited this tribe, and I was not a little surprised at their truly kind and hospitable reception of me; every thing they could offer was at my service, and in speaking of the transaction of 1821, the wives of the Sheik said, 'We have fought—you have made us every compensation for those who fell, and we should now be friends.'

"*Dec.* 6. I continued my journey to the S. S. W., forty-five miles over the desert, and the following day the same distance W. S. W., to some wells, and thence returned to the tents of Beni Bú Ali.

"*Dec.* 10. Journeyed forty two miles in a north-westerly direction, through the shallow valley of Wadi Butha, as far as Bedia, a district comprising seven small oases, which are fertile and beautiful past expectation.

"*Dec.* 13. Over the same country to Ibrah, an old town containing several handsome houses, with a population of about 700 persons, and thence continuing by the same shallow valley to Semmed, in lat. 22° 50′ N., an extensive oasis, with about 800 inhabitants; in its vicinity is a large fort, garrisoned by the Imám's troops—hence, in a W. S. W. direction, to Minna, an old town in a fertile and rich oasis, open fields beautifully cultivated, groves of almond, citron, and orange trees, so luxuriant that we exclaimed with astonishment, 'Is this Arabia, that has been represented as a desert?' fields of corn and sugar cane extended for miles before us, streams of water flowing in all directions, and the cheerful and contented appearance of the Arabs proved that all was plenty.

"*Dec.* 23. I reached Neswah, in lat. 22° 50′ N., which is the largest and most populous of all the oases; here we left our camels and procured asses to ascend the rocky heights of Jebel Akdár, or Green Mountain, which here extends, in an east and west direction, a distance of more than thirty miles. I ascended the range, which is of limestone, and reaches 6000 feet above the sea, and passed some days on the high table land; the surface is bare, but the ravines

* See Fraser's Journey to Khorasan, Appendix A.

well cultivated, and produce fruit and vegetables in abundance; the Beni-rehan tribe, which inhabit them, are not such fine-looking men as might be expected from their hardy life and mountainous abode, which may possibly be attributed to their immoderate use of wine, which, in spite of the precepts of the Koran, they indulge in, and excuse it on account of the cold they are exposed to; the wine resembles that from Shiráz. On my return to Neswah I made various short excursions into the desert to the southwest.

"*Jan.* 15. Owing to the malaria arising from a rank vegetation in an oasis at Neswah, I was seized with a fever, became delirious, and suffered severely; on regaining my senses, I was so weak that it was requisite to go to the sea coast for change of air, and therefore went to Síb, twenty miles N. W of Muskat, which is celebrated for its salubrity, and here remained till the end of February. I then started again along the coast, as far as Suìk, sixty miles farther to N. W., whence I turned into the interior of the country in a S. W. direction, till we reached Makinyat on the 10th of March; this was once a large town, but now is nothing more than a straggling village, never having recovered from a visit made to it in 1800 by the Wahabis—it stands in 23° 21′ north latitude, forty two miles from the nearest point of the coast at Khobúr. We hence continued in a W. N. W. direction, over a succession of barren and sandy plains to Obri, where, to our annoyance, we found 2000 Wahabís had taken possession of it; they were proceeding to attack Bedía, and when they found we were traveling under the Imám's protection, it was with some difficulty I escaped from them without being pillaged or murdered. I was therefore obliged to retrace my steps to Suík, on the coast, and went by sea to Shinás, in hopes of reaching Brémah, but in vain. The province of Omán extends about three hundred and fifty miles from Cape Musseldom on the north, to the island of Mazeira on the south, with an average breadth of one hundred and twenty miles, yet this seems very ill defined; it is divided into four districts, namely, 1. Batnah, extending in a narrow strip along the coast, from the northward, as far as Síb; 2. Darrah, parallel to the former, but in the interior; 3. Omán, comprising the central parts, and Muskat; 4. Jalian to the southeast.

"It may be described as a desert, thickly studded with oases, and containing amidst its mountains many fertile valleys, yet the cultivated parts bear but a small proportion to that which is barren.

"The average height of the range of mountains which runs throughout the extent of this part of Arabia is from 3000 to 3500 feet; yet the highest points of Jebel Akdár exceed 6000 feet above the sea; the width of the range is from twelve to fifteen miles; feldspar and mica slate enter most commonly into the formation of the lower ranges, and limestone the upper; with the exception of Jebul Akdár, they are devoid of wood, and barren."

The interest of this memoir was very much heightened by the exhibition of a beautiful map, showing the traveler's route throughout a distance of seven hundred miles by land, and, by the various explanations and illustrations given by Mr. Wellsted, who was present during the reading of this narrative, which is a most valuable addition to the geography of the hitherto unexplored country of Arabia.—*Athenæum, April*, 1837.

10. *Meteorological Tables for the year* 1836,* *prepared by the Meteorological Department of the St. Louis Association of Natural Sciences.*

TABLE I.—*Showing the temperature in* 1836, *compared with the average mean temperature of seven years.*

Months.	1836. Maximum.	Minimum.	Range.	Mean.	Average mean temperature of seven years.
January,	50.0	0.5	49.5	30.9	29.5
February,	68.0	8.5	76.5	32.5	34.5
March,	70.2	7.2	63.0	38.3	42.7
April,	89.4	28.6	60.8	58.5	58.6
May,	97.2	47.7	49.5	68.9	65.2
June,	99.5	56.7	42.8	74.5	73.1
July,	98.4	61.2	37.2	78.6	78.1
August,	93.9	52.2	41.7	73.6	74.6
September,	92.7	45.5	47.2	67.8	66.9
October,	87.1	24.1	63.0	48.4	55.8
November,	70.2	16.2	54.0	40.8	49.2
December,	53.2	1.7	54.0	29.9	33.7
Whole year,	99.5	8.5	108.0	53.5	55.2

TABLE II.—*Showing the state of the weather and prevailing winds in* 1836, *compared with an average of four years.*

Months.	Dry days. Clear.	Change.	Cloudy.	Wet days Rainy.	Snowy.	Sunshine.	No sunshine.	Thunder storms.	Winds.
January,	9	9	4	7	2	19	12	—	S. E.—W.—N. W.
February,	5	11	1	6	6	23	6	1	N. W.—S. E.—S. W.
March,	15	8	1	5	2	27	4	2	N. W.—S. E.
April,	9	11	1	9	—	28	2	10	N. E.—S. E.
May,	10	11	—	10	—	28	3	7	S. E.
June,	3	18	—	9	—	29	1	2	S. E.—N. W.
July,	7	17	—	7	—	30	1	7	S. E.—N. W.
August,	5	14	—	12	—	28	3	5	N. W.—S. E.
September,	10	8	—	12	—	27	3	6	N. W.—S. E.
October,	12	10	—	9	—	27	4	3	N. E.—N. W.
November,	14	6	1	7	2	24	6	1	S. E.—S. W.
December,	14	7	—	6	4	25	6	2	S. E.—S. W.—N. W.
Whole year,	113	130	8	99	16	315	51	46	S. E.—N. W.
	251			115		—	—	—	
Average of four years.	138	109	13	92	13				
	260			105		314	51	53	

An aurora borealis was seen Oct. 12th, at 2 A. M.

These tables are the result of observations made three times daily, viz. at sunrise, at 2 o'clock, P. M. and at 9 o'clock, P. M. The thermometer from which they were taken was kept at the north side of a house, where it was never exposed to the rays of the sun, and where the northern and western winds had constant access. The instrument was elevated sixteen feet above the ground, and fifty above the level of the Mississippi river.

* A continuation of these notices will be acceptable.—ED.

11. *A System of Mineralogy: including an extended Treatise on Crystallography: with an Appendix, containing the application of Mathematics to crystallographic investigation, and a Mineralogical Bibliography. With* 250 *wood cuts and four copperplates, containing* 150 *additional figures.* By James Dwight Dana, A. M. Assistant in the department of Chemistry, Mineralogy and Geology in Yale College; member of the Yale Nat. Hist. Soc., and of various other scientific societies. "*Hæc studia nobiscum peregrinantur, rusticantur.*" New Haven: Published by Durrie & Peck, and Herrick & Noyes, 1837, large 8vo. pp. xiv and 580.

We consider this volume a very important accession to our mineralogical literature, and one which we are sure will be gladly welcomed by every lover of science. A work of this extent and value has just claims upon us for a notice of its distinctive features and some general account of its contents.

The body of the work consists of six distinct parts, viz.

Part 1. Crystallology, or the science of the structure of minerals, p. 5–68.
2. Physical properties of minerals, p. 71–86.
3. Chemical properties of minerals, p. 87–90.
4. Taxonomy, or principles of classification and nomenclature, p. 92–103.
5. Determinative mineralogy, p. 105–148.*
6. Descriptive mineralogy, p. 145–445.

In Part I, we have, after the usual preliminary definitions, a comparative view of the primary forms, accompanied by an analytical table which shows at a glance their mutual affinities and dependencies; after which are descriptions of the primaries and the particulars of their mutual relations, with illustrative figures so arranged as to exhibit the transition of one form into another. Next follow remarks on the crystallographic axes of crystals, and a classification thence resulting of these forms into what are termed *Systems of Crystallization*, which are seven in number. This mode of grouping the primary forms is, to use the words of Whewell, "so scientific and yet so simple, that it is irresistibly superseding the older Haüyian arrangement, and the more so, as it is strikingly confirmed by the optical properties of crystals." The practical value of this classification is apparent in the first Analytical Table given by the author for the determination of species, inasmuch as we may often decide to which of these systems a mineral under examination pertains, without being able to determine what is the particular primary form. To these systems of crystallization, the author has applied the following nomenclature, partly derived from other authors and in part original; viz. the *Monometric*, including the cube, regular octahedron and rhombic dodecahedron;—*Dimetric*, the right square prism and square octahedron;—*Trimetric*, the right rectangular and rhombic prisms, the rectangular and rhombic octahedrons;—*Tetraxonal*, the rhombohedron and hexagonal prism;—*Monoclinate*, the right rhomboidal and oblique rhombic prisms;—*Diclinate*, the oblique rectangular prism;—*Triclinate*, the oblique rhomboidal prism. The laws for the occurrence of secondary planes are explained with much particularity and illustrated by an extensive series of figures. Next follow remarks on the lettering of figures of crystals and an explanation of the system adopted by the author, which every one will see, is vastly preferable to the method (if it deserves the name,) which now prevails. We have no room to state it, but we can confidently say that its general adoption would save the student much perplexity, (since a mere inspection of a figure thus lettered, informs him on what edges or angles the secondary planes there given are situated,) and would also greatly facilitate the comparison of different figures. The chapter on the means of detecting the primary forms of crystals, by goniometrical measurements, observation of cleavage, situation of secondary planes, &c. is quite extensive and satisfactory. It is followed by one treating of compound crystals and of aggregations of imperfect crystals.

We now come to the section on Theoretical Crystallogeny, in which, after a brief history of the science, the author unfolds his own original views of the ultimate structure of crystals. These were first made public in the thirtieth volume of this Journal. After much examination of this matter, we do not hesitate to declare our opinion that this mysterious problem, which since the days of Epicurus, has been so often unsuccessfully attacked, is at length here solved. Many facts which at first seem to be exceptions to the universality of the laws which this discovery develops, are shown to be its legitimate and even necessary results; and many curious phenomena which no other theory can interpret, are by this beautifully explained. Enough is already known to ensure the stability of this new theory; the progress of discovery, will, we are sure, only contribute new confirmation of its truth. A brief chapter on Practical Crystallogeny concludes this Part.

Part II, treats of the Physical characters of minerals, or those depending on light, electricity, magnetism and specific gravity; also of the hardness, state of aggregation, kinds of fracture, and odor.

Part III, consists mainly of directions for the use of acids and of the blowpipe.

Part IV, treats of the classification and nomenclature of minerals, and discusses the relative importance of crystallographic, physical and chemical characters in determining identity. The author here brings forward the classes and orders of his natural classification, the genera and species of which are given in Part VI. The classes, and in general the orders, are similar in their characters to those of MOHS. The following is the statement of its grand divisions.

Class I, EPIGÆA, (containing two orders) includes the gases, unmetallic liquids and soluble minerals. They have in general resulted from the decomposition of other species and are consequently epigæan or superterraneous. Their specific gravity is below 3·8.

Class II, ENTOGÆA (twelve orders) comprises those insoluble minerals which occur in or compose the several rock strata, and which are therefore appropriately described as occurring *within* (ἐντος) the earth. Specific gravity above 1·8.

Class III, HYPOGÆA, (two orders) contains those species that are literally hypogæan, or have resulted from the inhumation of vegetable or animal matter. Spec. grav. above 1·8.

Part V, contains two new tabular classifications the object of which is to enable the unaided student to arrive at the names of minerals. The first includes all crystallized minerals and is arranged according to the systems of crystallization before mentioned. These classes (with the exception of the class Triclinata) are each divided into two sections, according to their *unmetallic* or *metallic* lustre. The individuals in these sections are arranged in the order of their hardness, under the heads of *hardness*, *gravity*, *cleavage*, *lustre*, *color*, *diaphaneity*, &c. The second table is independent of crystallization, and is distributed into the three grand classes before named, subdivided into sections and subsections depending (with the exception of the individuals of Class I,) on their metallic or unmetallic lustre and their colored or uncolored streak. The species in these several subdivisions are arranged in the order of their hardness, under the heads of *hardness*, *gravity*, *structure*, (including references to the system of crystallization,) *lustre*, *color*, *diaphaneity*, *effects of acids and of the blowpipe.* The minerals in several of the sections are moreover again arranged according to their specific gravity. The manner of using these tables is next explained. They cannot fail to be of great utility. We have no where seen given any method by the use of which the student can so surely and so readily arrive at the names of minerals.

Part VI, opens with the catalogue in full, of the classes, orders, genera and species of the mineral kingdom, arranged according to their natural affinities; the nomenclature being in the Latin tongue, in conformity with the practice in other departments. This reformation of the nomenclature of Mineralogy, is by no means the smallest merit of the peculiarities of this work. Hitherto, since the abandonment of the systems of some of the successors of Linnæus, this part of science has been "a jumble of terms derived from almost every language, whether dead or living, and almost every system, founded upon no common principle, and equally destitute of precision and simplicity." The Latin is the only tongue in which the names of minerals can constitute a common language throughout the civilized world; and the mode of denominating the species by a binary name, which has so long been advantageously employed in zoology and botany, will doubtless be found equally useful in mineralogy. The construction of so many new words was certainly a work of difficulty, yet the task has been very successfully performed. We think that among these names, there will be found less to offend the ear and to embarrass the organs of utterance, than in an equal number taken at random from any book of descriptive botany or zoology.

The descriptions of species are next given, and occupy nearly three hundred pages. They are succinct and methodical, and in most cases illustrated by figures of the more common secondary forms. To the descriptions are added the composition, economical uses, and localities, together with any other particulars of interest. Accompanying the trivial names, are copious catalogues of synonyms, which are rendered available to the inquirer, by being registered in the index.

We pass now to Appendix A, (occupying 80 pages,) which is a very important portion of the work, and one of its chief peculiarities. It is entirely occupied with a treatise on the application of mathematical calculation to crystallographic investigation. This portion is the more worthy of attention, since nothing on the subject has ever been published in this country. Its character is sufficiently stated when we say that it is a judicious abstract of NAUMANN's unrivalled work on

Crystallography. The means of calculation employed by that distinguished author, are those furnished by Geometrical Analysis, of which he says, "it is and must be the simplest and most natural of all methods." The practical value of these calculations, appears from the following remarks of the author:—"the determination of a single angle in a dimetric or tetraxonal solid, is, in some instances, sufficient for ascertaining every angle, interfacial or plane, that the solid contains, and often in the monometric solids not even this datum is required."

Appendix B, is occupied with a discussion of the chemical classification of minerals, and a tabular view of the same.

The work is concluded by a Mineralogical Bibliography, of seventeen pages, containing 1st, a catalogue of all the ancient works on this science, with a selection of the most important ones of modern times, and 2d, a catalogue of all American publications on mineralogy, both original and reprinted, and likewise a list of all the articles on this topic, scattered through the American periodicals. Catalogues of this nature have always been held valuable. They furnish information which few have the opportunities of collecting, and are of the utmost importance to those who make original investigations. We here see how little this nation has, until recently, done for the advancement of a science, a knowledge of which is so important to the full development of the resources of the country. This cause of reproach is now however fast disappearing. The institution of geological and mineralogical surveys in most of the states, does great honor to our legislators, and must contribute much to extend the boundaries of science. Many minerals now unknown, are doubtless reserved to reward the search of future explorers. Within a short space of time and a limited extent of territory, three new species (viz. Microlite, Edwardsite, and Eremite) have been added to the domain of Mineralogy, by one of the most zealous and accomplished cultivators of this science among us. We trust that many in other parts of the land will imitate his zeal and be alike successful.

The mechanical execution of the book merits commendation. The figures both on wood and copper are made with much neatness and accuracy, and the printers have evidently spared no pains in contributing their part towards the execution of a text book, superior in typographical excellence to any of its American predecessors.

The industry, research and scientific attainments evinced in the execution of this work, afford satisfactory evidence of the ability of the writer, and give a pledge of future equally successful labors in the same field. On the whole, we believe this to be decidedly among the best treatises upon this subject that have ever been circulated in the United States, and we are of the opinion that even a slight examination of it, will be sufficient to commend it to the favor of every cultivator and lover of Mineralogy.—*Communicated.* T.

12. *Transactions of the Natural History Society of Hartford, Conn.* No. 1, Vol. I. Hartford, Connecticut, 1836.—This is the first scientific publication of this recently organized body. Sixty four pages are occupied by an address from the Rev. Dr. Jarvis, of Washington College, President of the Society, on the rise and progress of Natural History. This sketch is graphic, lucid and as comprehensive as the limited space would allow; occasionally it is eloquent, and his appeal to his fellow citizens on behalf of the Society, is peculiarly appropriate and cogent. He gives also a short outline of the progress of Natural Science in this country; as full, perhaps, as an impartial review of living men would allow. The remainder of the number is occupied by an entomological article, entitled, *Characteristics of some previously described North American Coleopterous Insects, and descriptions of others which appear to be new in the collection of Mr. Abraham Halsey: by T. W. Harris, M. D., Librarian of Harvard University. Communicated Dec.* 23, 1835.

This number is very creditable to the society, and we sincerely hope they will meet with every encouragement necessary to the successful prosecution of the object of their organization.

13. *Meteors at Hingham.*

Hingham, Mass., (near Boston,) March 12, 1837.

To Professor Silliman.—*Dear Sir*—Having observed in the last number of the "American Journal of Science," &c. several accounts of the meteoric shower on the morning of 13th Nov. 1836, and deeming it a service to science to record every circumstance, which may serve to advance its interest, I forward to you my own experience.

Rising at an early hour, my attention was attracted to the subject, by the flight of a very large luminous meteor, which passed towards the west. This occurred at half past four. It seemed to be very low and greatly resembled a sky rocket, leaving behind a train of sparks, such as usually accompanies these artificial pyrotechnics.

From this hour, until daybreak, seventeen others fell, all of which, with a single exception, were small, many faint, and of the appearance of "shooting stars" as they are generally termed, such as are seen on any clear evening. The other was large and brilliant, resembling the one first mentioned, but appeared at a greater height, though accompanied by a beautiful train of sparks. These seventeen seemed to fall towards the southeast and southwest. Three flashes of lightning were distinctly visible at distant intervals of time, on the very edge of the southern horizon. A stratum of faint clouds, like mist, overhung that portion of the horizon, unlike the cloud which always accompanies the aurora borealis. The rest of the sky was clear and bright and the atmosphere delightfully serene. Although in all, there were but eighteen meteoric bodies, yet the circumstances and time seemed clearly to denote the mysterious return of that gorgeous shower which attracted such universal attention.

You will observe that the space of time was from half past four o'clock to daybreak, about two hours. Perhaps the phenomenon I had the pleasure of witnessing was only the conclusion of a greater display. With sentiments of respect, yours, &c.

John Lewis Russel.

14. *Auroral Appearance.**—A a quarter past nine o'clock on Sunday night the eighth day of May, in the present year, my attention whilst regarding the heavens was forcibly attracted to the sudden appearance due east of a shining broad column of light.

At first, as my window overlooks the bay of Toronto and the low island which separates it from the lake, I took this singular pillar of light for the reflection from some steamboat on the clouds, but having sought the open air on the gallery which commands a full view of the bay and of Ontario, I was convinced that the meteor was an

---

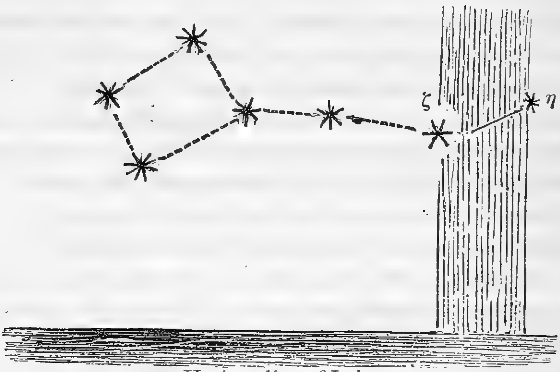
* Toronto, Upper Canada, Dec. 3d, 1836.

To Professor Silliman.—As every thing relating to meteorology is of importance and should be recorded, I have sought amongst my papers, for some notices of a singular appearance in the sky on Sunday evening the eighth of May, 1836, which I had overlooked, but which I now think it right to communicate to your valuable Journal, wherein I perceive the subject of auroral phenomena has latterly been much discussed. I have been led to seek more after opportunities of witnessing and recording these appearances in the heavens, from having read the "Observations on solar and lunar columns, halos, the aurora and auroral clouds," by Professor Joslin, of Union College, State of New York, whom I beg to thank for his politeness in sending me his work. Very sincerely, yours,

R. H. Bonnycastle.

effluence of the sky, as I now saw it extend upwards from the eastern water horizon line to the zenith, in a well defined, equal, broad column of white strong light, resembling in some degree that of the aurora, but of a steady brightness and unchanging body, whilst there were few or no clouds. Ursa Major, then near the zenith, was situated with regard to this column, at a quarter past nine as below, the column passing nearly vertically between ζ and η.

Zenith.



Horizon line of Lake.

There was no moon, as on that day it rose at $2h.$ $4m.$ consequently it was dark, and as the sky was not very cloudy the meteor was seen to the greatest advantage as the night wore on. It passed very slowly and bodily to the westward, continuing to occupy the space from the horizon to the zenith, until the upper part first faded slowly and then the whole gradually disappeared, after it had reached nearly to due northeast. I had unfortunately broken my thermometer and could therefore only state that the weather was cold, and that there was no wind. At twenty five minutes past nine o'clock the pillar of light had vanished, but it immediately afterwards reappeared slightly in the horizon where it had been last seen, and in the mean time the constant auroral arch of the halos I have before mentioned, in Vol. 30. p. 131, became visible in the northern horizon, and increased very rapidly in brilliancy, and at ten minutes to ten gave so intense a glow to the sky that it was light enough to enable me to see the objects around distinctly as in pale moonlight. It was in short equal to the light of the moon at the end of the second quarter.

The auroral arch rose very high on this occasion and then flattened, and at ten the double arch, I have already described, was peculiarly beautiful, the darkness under it being singularly grand.

I thought it better, although nothing scientific, as there are no instrumental details in this slight notice, not to lose it altogether and therefore send it to you as it is, with "all its imperfections on its head," as from a variety of even such slight and informal observations there would be "much matter to be learned," particularly as I do not consider the almost stationary column of white light first appearing in the east, before the aurora began, as being of an auroral character, its motion, its peculiar wild and steady lustre and the uniform breadth which it preserved from the horizon to the zenith, distinguishing it from the fanciful and shooting flashes of the auroral columns.

15. *Meteorite.*—A notice in the Boston Daily Advertiser of June 10, 1837, states that a meteoric stone is reported to have fallen between three and four P. M. May 5, at East Bridgewater, (Mass.) The only witness was a lad of 15 years of age, who was alarmed by what he supposed to be a stroke of lightning in a neighboring field. Being at play with considerable noise, he did not observe any report, but thought there was scintillation and that the meteor might have burst before it reached the earth, which is said to have been somewhat torn up, and several pieces of the stone were found yet sensibly warm, and were seen and examined by several persons. Nine pieces of the stone were obtained, weighing in the whole half a pound, and the largest piece a quarter of a pound; four other pieces were afterwards found in such a position as to indicate that they may have been separated before the meteor reached the ground.

The whole stone appears vitrified as if from rapid cooling. The outside is black, glazed and shining, but within it is gray and full of oval shaped cavities. It is attracted by the magnet and resembles the lava or the scoria of a furnace, which latter substance the writer of the notice would have taken it for, had it not been reported to be warm when taken up. The sp. gr. of four fragments weighing respectively 85.50, 73.52, 43.30, and 28.75 grains, was found to be 2.611, 2.083, 1.728, and 2.815, mean 2.159.

We have thought it right to preserve this notice, although we have not seen any specimen of the stone. The specific gravity being less than that of common stones, and not much more than half of the usual weight of meteorites, while the substance is still attractable by the magnet, must of course imply a considerable degree of inflation and of course a violent and legible effect of heat.—*Ed. Am. Jour.*

16. *Aurora Borealis of February* 18, 1837.—A very beautiful display of Northern Lights was witnessed on the night of the 18th February last, at London, Belfast, Paris, Göttingen and many other places in Europe. At Göttingen it was visible from 7 P. M till 2 A. M of 19th inst., and according to the observations of GOLDSCHMIDT,* produced a very sensible disturbance of the magnetic needle. The range of the needle's variation was about 20′, and its movements rapid.

It is an interesting fact, that on this same evening the Aurora Borealis was visible at this place, (distant 83° of long. from Göttingen,) and that its effect on the magnetic needle here was very manifest. Soon after sunset, the east to the altitude of 40° was tinged with a faint purple color, and from the end of twilight until about 9 P. M, a broad indefinitely-bounded zone of a dim red, spanned the heavens from east to west. It was however too indistinct to attract much attention. At 9*h.* 15*m.* P. M. mean time, a region about 10° wide and 15° high, (having its center at N. 30° E.,) was lighted up with a beautiful rose-red. Without any perceptible change of position, this illuminated region was visible till 11 P. M., (when the observations ceased,) often varying in intensity from a deep rose-red to a faint and scarcely appreciable stain. During this time, no auroral light was seen in any other part of the sky. The needles of a Variation Transit and of a theodolite were first inspected at 9*h.* 20*m.* and the north end of each was then found about 15′ east of its usual position at this hour. At 9*h.* 22*m.* the variation reached its maximum, viz. 35′ east of the mean.† From this period until 11 P. M., the needle moved back and forth, at times with considerable rapidity, and almost wholly on the eastern side of its mean direction. The times above given are uncertain within three minutes.

New Haven, Conn. E. C. H.

17. *The Production of Galvanic Music.*—The following experiment was communicated by Dr. C. G. Page of Salem, Mass., in a recent letter to the editor. From the well known action upon masses of matter, when one of those masses is a magnet, and the other some conducting substance, transmitting a galvanic current, it might have been safely inferred (a priori,) that if this action were prevented by having both bodies permanently fixed, a molecular derangement would occur, whenever such a reciprocal action should be estab-

* L'Institut, April 5, 1837.

† N. 5° 55′ W.

lished or destroyed. This condition is fully proved by the following singular experiment. A long copper wire covered with cotton was wound tightly into a flat spiral. After making forty turns, the whole was firmly fixed by a smearing of common cement, and mounted vertically between two upright supports. The ends of the wire were then brought down into mercury cups, which were connected by copper wires with the cups on the battery, which was a single pair of zinc and lead plates, excited by sulphate of copper. When one of the connecting wires was lifted from its cup a bright spark and loud snap were produced. When one or both poles of a large horse shoe magnet, are brought by the side or put astride the spiral, but not touching it, a distinct ringing is heard in the magnet, as often as the battery connexion with the spiral is made or broken by one of the wires. Thinking that the ringing sound might be produced by agitation or reverberation from the snap, I had the battery contact broken in a cup, at considerable distance from the field of experiment; the effect was the same as before. The ringing is heard both when the contact is made and broken; when the contact is made, the sound emitted is very feeble; when broken it may be heard at two or three feet distance. The experiment will hardly succeed with small magnets. The first used in the experiment, consisted of three horse shoes, supporting ten pounds. The next one tried was composed of six magnets, supporting fifteen pounds by the armature. The third supported two pounds. In each of these trials the sounds produced differed from each other, and were the notes or pitches peculiar to the several magnets. If a large magnet supported by the bend be struck with the knuckle, it gives a musical note; if it be slightly tapped with the finger nail, it returns two sounds, one, its proper musical pitch, and another an octave above this, which last is the note given in the experiment.

18. *The American edition of Dr. Buckland's late Work on Geology and Mineralogy, considered with reference to Natural Theology.* Carey, Lea & Blanchard, 2 vols. 8vo. Phil.

We are happy to see this admirable work laid before the American public. We have already recorded our favorable opinion of it, and a reiterated perusal and study only confirm the conviction of its high claims to the attention of the scientific and religious world. Both its physical and moral demonstrations are of the highest order, and it has settled forever (if it had not been settled before,) the great antiquity of our planet and the wisdom of the arrangement, which made it necessary that ages should elapse, in order to prepare it for its grand object the reception of man.

The consistency of all these things with the Genesis, is ably illustrated by Dr. Buckland, in a preliminary discourse, and we are fully convinced that nothing is necessary to a universal and just conviction on that subject, but *a full knowledge of the facts, without which it is impossible to judge in the case.*

In this American edition, all Dr. Buckland's admirable graphic illustrations are preserved and beautifully executed.

This work is very appropriate to the library of clergymen, and we hope it will be not only read but studied by all who feel an interest (as all ought to feel,) in the great questions about which it is conversant.

19. *Incidents of Travel in Egypt, Arabia Petræa and the Holy Land;* by an American, with a map and engravings, in 2 vols. 12mo.

We have derived much instruction and pleasure from a perusal of this work of Mr. Stevens. It is replete with valuable and interesting information on Egypt, Arabia, Idumea and Palestine, countries which both sacred and profane history have, for ages, commended to our deep regard and profound veneration.

The author is a man of quick and accurate perceptions; he conveys his impressions with great energy, eloquence and beauty, and with a peculiarly happy and graphic tact, he hits off every subject, with sketches so strong and vivid, that the scene whether grave or ludicrous, is placed fully in our view.

One who has mounted the pyramids of Egypt, explored her tombs and her immense ruins, ascended one thousand miles to the cataracts of the Nile, conversed with the Pacha, crossed the Red sea where the Israelites did, climbed mount Sinai and mount Hor, who has surveyed the colossal remains of the long lost city of Petra, the capital of Edom or Idumea, floated on the waters of the Dead sea, as a bath, and domesticated himself among the holy places of the Holy city—such a man will *command* our attention, and we hazard nothing in saying, that no one who begins to read Mr. Stevens' volumes will willingly lay them down until the perusal is finished. This work is a happy sequel or companion to that of the Rev. George Jones, and like that will add, if possible, to the confidence and veneration with which the early bible history is justly regarded.

20. *Earthquake.*—An earthquake occurred at Hartford, Conn. on the 12th of April, 1837. It was very slight, yet sufficient to jar all loose articles and swing the pendant lamps; in one house a bell was made to ring, and some of the inhabitants in that part of the town called Wethersfield lane, ran out of their houses, thinking they were about to fall.

21. *Edmonson's Revolving Magnet.*—In the notice published in our last No. of the revolving electro-magnetic machine of Mr. Davenport, we forgot to mention that of Mr. Edmonson, of Baltimore, which was figured and described in Vol. 26, at p. 205, of this work, to which the reader is referred.

22. *Electro-magnetic Machine of Davenport & Cook.*—We are informed that they have constructed a seven inch wheel, with two tiers of magnets in the revolving part, or four crosses, which will be applied to a turning lathe, and will raise over one hundred lbs. from the floor. They find sulphate of copper forms the best excitant for the battery, with which the machine will run a long time, without exposing the battery to the atmosphere, or heating the same too much.

We have not received any drawings or other illustrations, regarding this machine, as was intimated in the report in our last number, that we might now present to our readers. We understand the proprietors are not yet ready.

23. *Geological Survey of Connecticut.*—The Report of Prof. Shepard on the Economical and Scientific Mineralogy of the State, is now in press in this city, and will shortly be published in accordance with the resolution of the General Assembly at its recent session in Hartford. The publication of the Geological Report is deferred until another year, in order to enable Dr. Percival, the commissioner to whom this part of the survey was entrusted, to complete the necessary examinations.

24. *Asia Minor.*—M. Texier, in his summary account of the geological construction of Asia Minor, describes the Black Sea, of which it has hitherto been supposed that, in consequence of some violent shock, its waters opened a passage for themselves, and in so doing caused the deluge of Samothracia; but on examining the two sides of the Bosphorus, M. Texier says, they are of such different

strata, that they never can have been united. The European side is composed entirely of trachyte and analogous rocks, and the Asiatic of transition limestone. The trachytes have a blue ground with white crystals, and extend in width of several leagues as far as Belgrade and Kila. If the Bosphorus diminish, as reported, it is probably owing to the effusion of the trachytic rocks on the European side.—*Athenæum, May*, 1837.

25. *Silex.*—M. Turpin has submitted the silex sent from Berlin by M. Ehrenberg, to microscopic observation. The magnifying power amounted to 260, and this gentleman found, that the semi-opal of Berlin is a conglomerate of a number of siliceous particles and fragments of organic remains, the color of which varies from transparent white, and passes through yellow, to the deepest and most opaque brown. M. Turpin recognized four different bodies; the first of which he referred to the genus *Gaillonella* of M. Bory St. Vincent, or *Conferva moniliformis;* the second he considered as a different species of the same genus; the third was a mixture of tubular filaments, divided into cells at rare intervals, and remains of infusoria; the fourth was not organic, but served as a basis for rendering the whole solid. The *Silex pyromaque* of Delitzsch, is much richer in organic productions, offering some very remarkable forms, probably belonging to the eggs of Polypi.—*Ib.*

26. *White Race of Atlas.*—M. Guyon, chief surgeon to the African army, writes to M. Dureau de la Malle, that at Bougia there is now living, a woman originally from the interior, supposed to be descended from the white tribe of Mount Aureps. She is at most twenty six or twenty-eight years of age, of very agreeable physiognomy, blue eyes, fair hair, beautiful teeth, and has a very delicate white skin. She is married to the Imaun of the mosques, Sidi Hamed, by whom she has three children, bearing a strong resemblance to herself. M. Arago observes, that these white people are not so rare in that part of the world as might be supposed, for when he was going from Bougia to Algiers, in 1808, by land, he saw women of all ages in the different villages, who were quite white, had blue eyes and fair hair, but that the nature of his journey did not permit him to stop and ask if they came from any peculiar tribe.—*Ib.*

INDEX TO VOLUME XXXII.

A.

Academy of Science and Literature, transactions of the Maryland, 204.
Acid, œnanthic, 382.
Adhesion of iron spikes of various forms in different kinds of timber, 34.
Air, curious effect of current of, on the flame of a lamp, 88.
Alexander, J. H. and J. T. Ducatel, report on the new map of Maryland, 191.
Animal electricity, 198.
Arabia, on the province of Oman, on the east coast of, 383.
Asaphus, a new species of, 169.
Asia Minor, 399.
Astronomy, notice of Gummere's, 208.
Atlas, white race of, 400.
Aurora Borealis, observations on by D. Olmsted, 176.
——— of Feb. 18, 1837, 396.
Auroral arch of August, 1836, 220.
——— of May, 1836, 224.
——— cloud of December, 1835, 217.
——— streamers, dip of, 227.
——— and optical phenomena, observations upon, 217.

B.

Bailey, J. W., excursion to Mt. Katahdin in Maine, 20.
———, notes on chemistry, 85.
———, on the common blowpipe, 319.
Barometer gage eudiometer, 280.
Battery discharger for deflagrating wires, 274.
Beech trees, interlocking of, 379.
Bennet, E. T., obituary notice of, 215.
Berzelius, letter from, on chemical nomenclature, 262.
Blowpipe, common, 319.
———, reaction of the principal metallic oxides with the three fluxes, 323.
Boston society of natural history, report of the curators of, 364.
Botany, Lindley's Introduction to, 210.
———, Lindley's Natural System of, 211.
———, review of do. 292.
Boulders in the northern part of N. York state, 233.
Bricks, fire, 195.
Buckland's new work, remarks on, 210.
———, American edition, notice of, 397.

C.

Calc spar, new locality of, 234.
Calymene, a new species of, 167.
Cameos, remarks on, 257.
Cardium edule, economical notice of, 254.
Cements, nature of, 200.
Chama gigas, economical notice of, 256.
Chemical nomenclature, remarks on, by R. Hare, 259.
——— tables of J. F. W. Johnston, notice of, 212.
Chemistry, notes on, 85.
Chronometers, 330.
Coccolite, green, locality of, 234.
Columbite, identity of Torrelite with, 149.
Combustion of phosphorus in nitrous oxide gas, 290.
Connecticut, geological survey of, 399.
Cowry, economical notice of, 250.
Crosse's galvanic apparatus, 372.
Cunningham, R., obituary notice of, 215.
Cycadeæ, remarks on the natural order, with a description of the ovula and seeds of Cycas revoluta, 45.
Cypræa moneta, economical notice of, 250.

D.

Dana, James D., identity of the Torrelite of Thomson with Columbite, 149.
———, remarks on the new system of mineralogy of, 387.
Davenport, T., electro-magnetic machine, appendix to No. 1.
Delaware river, shad fisheries of, 134.
Downing, A. J. remarks on the Cycadeæ, 45.
Ducatel, and Alexander, report on the new map of Maryland, 191.
Dynamic multiplier, on the use of, with a new accompanying apparatus, 354.

E.

Earthquake at Hartford, Conn., 399.
Economical uses of some species of testacea, 53, 235.
Edmonson's revolving magnet, 399.
Edwardsite, a new mineral, 162.
Elba, tour in, and mines and minerals of, 74.
Electrical battery discharges, for deflagrating wires, 274.
——— brush, 277.
——— machine, description of, 272.
——— spark, inferences from the phenomena of, 278.
——— zigzag spark, contrasted with the short straight spark, 275.
Electricity, animal, 198.
———, Galvanism, &c., notice of Sturgeon's annals of, 213.

Electro-magnetic machine of Mr. T. Davenport, appendix to No. 1, and 399.
———— engine, description of a model of, 313.
——— meteorological observations, 304.
Elephant, fossil remains of, 377.
Emmet, J. P., on formic acid, 140.
Eremite, new mineral species, 341.
Ether, œnanthic, the cause of the odor of wines, 381.
Eudiometer, barometer gage, 280.
Excursion to Mt. Katahdin, in Maine, 20.

F.

Faraday, improved galvanic deflagrator, 170.
Featherstonhaugh, G. W., geological report on the western territories, 185.
Fire-bricks, 195.
Fisheries of shad in Delaware river, 134.
Fishery of the European oyster, 245.
Fishes, fall of, from the atmosphere in India, 199.
Flame of lamp, curious effect of current of air on, 88.
Formic acid, remarks on, 140.
Fossil footsteps in sandstone and graywacke, 174.
——— remains of the elephant, 377.
——— trilobites, new species of, 167, 343.
Fourier, temperature of the earth and planetary spaces, 1.
France, tour in, by Prof. F. Hall, 74.

G.

Gale, L. D., on zinc roofing, 315.
Galvanic apparatus, Crosse's, 372.
Galvanic battery, new, 285.
——— deflagrator, 170, 288.
——— induction of metallic coils, 308.
——— music, production of, 396.
Galvanism, 197.
———, notice of Sturgeon's annals of, 213.
Galvano-ignition apparatus, 282.
Geology, remarks on Lyell's, 210.
———, notice of Mc Clelland's work on East Indian, 216.
——— and mineralogy, notice of the American edition of Buckland's late work on, 397.
Geological report, on the new map of Maryland, 191.
———— of the Missouri and Wisconsin territories, 185.
———— of Maine, 193.
———— of New York, 186.
———— of Ohio, 190.
———— of Pennsylvania, 192.
———— of Virginia, 192.
———— notices of the northern part of New York, 230.
——— survey of Connecticut, Shepard's report on, 399.
Gibbon, J. H., visit to the salt works near Bogota, at Zipaquera, in Granada, 89.
Glass, a substitute for metal balance springs in chronometers, 330.
Gold, in a portion of North Carolina, facts concerning, 130.
—— and gold region of Virgina, from the personal observations of B. Silliman, 98.
—— mine, near Fredericksburg, Virginia, 183, 325.
Graywacke, footsteps in, 174.
Green coccolite, locality of, 234.
Green, Jacob, description of new trilobites, 167, 343.
Guadaloupe fossil human skeleton, description of the skull of, 361.
Gulf stream, remarks on the supposed eddy current of, 349.
Gummere's Astronomy, remarks on, 208.

H.

Halos in January, 1835, 229.
Hartford, transactions of the Natural History Society of, 392.
Hare, R., causes of the tornado or water spout, 153.
———, tornado of New Brunswick, 158.
———, remarks on chemical nomenclature, 259.
———, description of an electrical machine, 272.
———, new battery discharger, 274.
———, long zigzag spark contrasted with the short straight spark, 275.
———, the electrical brush, 277.
———, on some inferences from the phenomena of the electric spark in a recent work on heat and elertricity, 278.
———, an improved barometer gage eudiometer, 280.
———, on the galvano-ignition apparatus, 282.
———, new voltaic series, 285.
———, galvanic deflagrator, 288.
———, combustion of phosphorus in nitrous oxide gas, 291.
Helix pomatia, 254.
Henry, Dr. Wm., obituary notice of, 216.
Hildreth, S. P., Meteorological Journal kept at Marietta, Ohio, 95.
———, report on the geological survey of Ohio, 190.
Hingham, meteors at, 392.
Hitchcock, E., footsteps in sandstone and graywacke, 174.
Howell, Samuel, shad and shad fisheries of the river Delaware, 134.
Hubbard, Oliver P., geological and mineralogical notices, 230.
Human skeleton of Guadaloupe, skull of the, 361.
Hyalite at West point, 87.

I.

Iceland, visit to, 196.
Induction of metallic coils, experiments upon, 308.
Infusoria in silex, 400.
Iron, mines of, in Elba, 74.
—— spikes, adhesion of, in different species of timber, 34.
Italy, tour in, by Prof. J. Hall, 74.

J.

Jackson, C. T., first report on the geology of the state of Maine, 193.
Jardine's Magazine of Zoology and Botany, 212.
Johnson, W. R., adhesion of iron spikes in different kinds of timber, 34.
Johnston, J. F. W., notice of the chemical tables of, 212.

K.

Katahdin, Mt., excursion to, 20.

L.

Lectures on the connection between science and religion, by N. Wiseman, remarks on, 209.
Lindley's, John, introduction to Botany, 210.
——— natural system of Botany, notice of, 211.
——— natural system of Botany, review of, 292.
Lyceum of Natural History of New York, officers of, 204.
Lyell's Geology, remarks on, 210.

M.

Magazine of Zoology and Botany, Jardine's, 212.
Magnet, Edmonson's revolving, 399.
Magnetic needle, variation of, during an aurora, 179.
Magneto-electric machine of T. Davenport, appendix to No. 1.
Marietta, Ohio, Meteorological Journal kept at, 95.
Maryland, report on the new map of, 191.
——— Academy of Science and Literature, transactions of, 204.
Maine, first geological report of, 193.
Maury, M. F., new treatise on navigation, 208.
———, gold veins of the U. S. mine near Fredericksburg, Va., 325.
McClelland's East Indian Geology, 216.
Metallic coils, experiments on the induction of, 308.
Meteors at Hingham, 392.
Meteoric shower of November, foreign accounts of, 181.
Meteorite, 395.
Meteorological journal kept at Marietta, Ohio, 95.
——— tables for 1836, by the St. Louis association of natural sciences, 386.
Microlite, chemical examination of, 338.
Minerals, notices of, 82, 149, 162, 234, 338, 341.
Mineralogy, new system of, by J. D. Dana, 387.
——— of Connecticut, C. U. Shepard's report on, 399.
Mineralogical and geological notices of the northern part of New York, 238.
Mines and minerals of Elba, 74.
Mines, gold, of Virginia, 98.
Mines, gold, Culpepper mine, 117, 185.
———, in Fauquier and Culpepper counties, 127.
———, Moss and Busby mines in Goochland county, Va., 99.
———, of the Virginia and New England Mining Company, 126.
———, near Fredericksburg, Va. 183.
———, in a portion of North Carolina, facts concerning, 130.
———, Walton mine in Louisa county, Va., 109.
Missouri and Wisconsin territories, report on the geology of, 185.
Morton, S. G., proposed new work on American skulls, 207.
Moultrie, James, description of the skull of the Guadaloupe fossil human skeleton, 361.
Mulberry, on the cultivation of, 211.
Mya margaritifera, history and economical uses of, 68.
Mya Pictorum, economical notice of, 248.
Mytilus margaritiferus, economical uses of, 56.
——— edulis, economical notice of, 252.
Murex ——? history and economical notice of, 235.
——— Tritonis, history and economical notice of, 239.
Music, production of galvanic, 396.

N.

Natural history, Lyceum of, at New York, 204.
——— Society of Hartford, transactions of, 392.
Navigation, new treatise on, 208.
New Brunswick tornado, 158.
New York, first report of the geological survey of the state of, 186.
Nitric acid, new test for, 85.
Nitrous oxide gas, combustion of phosphorus in, 290.
Nomenclature, chemical, remarks on by R. Hare, 259.
——— letter of Berzelius on, 262.
North Carolina, facts connected with the gold of a portion of, 130.

O.

Obituary notice of Dr. Turner, 213.
——— M. Persoon, 215.
——— R. Cunningham, 215.
——— E. T. Bennet, 215.
——— Dr. Wm. Henry, 216.
Odor of wines due to a peculiar ether, 381.
Œnanthic ether, 381.
——— acid, 382.
Ohio, geological report on the state of, 191.
Oil, essential, of potatoes, 382.
Olmsted, D. observations on the aurora borealis, 176.
Ostrea edulis, historical and economical notice of, 241.
——— scabra, historical and economical notice of, 247.

Oyster, European, historical and economical notice of, 241.

P.

Page, C. G., on the use of the dynamic multiplier, 354.
Pecten maximum, history and economical notice of, 248.
——— concentricum, notice of, 249.
Pennsylvania, first report on the geology of, 192.
Persoon, obituary notice of, 215.
Phosphorus, combustion of, in nitrous oxide gas, 290.
Pinna rotundata, historical and economical notice of, 70.
Planetary spaces, temperature of the terrestrial globe and, 1.
Potatoes, essential oil of, 382.

R.

Rainbows, supernumerary, 227.
Records of science, notice of Thomson's, 212.
Redfield, W., C. on the supposed connection of the gulf stream with the opposite currents on the coast of the United States, 349.
Report of the curators of the Boston society of Natural history, 364.
Robert, Mons. Eugene, visit to Iceland, 196.
Rogers, H. D. first report on the geology of Pennsylvania, 192.
——— Wm. B. report on the geological reconnaissance of Virginia, 192.
Roofing with zinc, 315.
Rotting of timber in certain situations, 380.
Royal geographical society, 383.

S.

Salt works of Zipaquera in New Granada, 89.
Sandstone, footseps in, 174.
Shad and shad fisheries of the river Delaware, 134.
Shells, economical uses of some species of, 53, 235.
——— used for fancy work, 257.
——————— as a circulating medium, 258.
——— fish, disease amongst, 97.
Shepard, C. U., chemical examination of Microlite, 338.
———————, description of Edwardsite, a new mineral, 162.
———————, Eremite, a new mineral, 341.
———————, report on the mineralogy of Connecticut, 399.
Silliman, B., on gold mines and region of Virginia, 98.
Skeleton, human, of Gaudaloupe, 361.
Skulls, American, proposed new work on, 207.
Smith, F. L., facts connected with the gold of a portion of North Carolina, 130.
Snail, edible, economical notice of, 254.
Society, New York statistical, 202.
Statistical society of New York, 202.
Storer, D. Humphreys, report of the curators of the Boston society of natural history, 364.
Storms, adoption in England of Mr. Redfield's views on, 197.
Sturgeon's annals of electricity, &c., 213.
Swaim, James, electro-meteorological observations, 304.

T.

Telegraphs, 201.
Temperature of the terrestrial globe and the planetary spaces, 1.
Terrestrial globe, temperature of, 1.
Testacea, economical notice of some species of, 53, 230.
Thomson's Records of science, notice of, 212.
Timber, rotting of, 380.
Tornado of New Brunswick, 158.
——— causes of, 153.
Torpedo, electricity of, 198.
Torrelite of Thomson, identical with Columbite, 149.
Tour in France, Italy and Elba, by Prof. Hall, 74.
Trees, beech, interlocking of, 379.
Transactions of the Natural history society of Hartford, 392.
Travels in Egypt, Arabia, &c. incidents of, 398.
Trilobites, new, 167, 343.
Turbo littoreus, economical notice of, 248.
Turner, Dr., obituary notice of, 213.
Twining, A. C., his observations upon certain auroral and optical phenomena, 217.

V.

Virginia, gold region of, 98.
——————— near Fredericksburg, 325.
———, report on the geological reconnaissance of the state of, 192.
Volcano at sea, 195.
Voluta gravis, economical notice of, 250.

W.

Water spout, causes of, 153.
Wellsted, J. R., on the province of Omán on the eastern coast of Arabia, 383.
Whelk, economical notice of, 248.
White race of Atlas, 400.
Wines, odor of, due to a peculiar ether, 381.
Wiseman's, N., work on the connection between science and revealed religion, notice of, 209.

Z.

Zabriskie, J. B., experiments upon the induction of metallic coils, 308.
———————, model of an electro-magnetic engine, 313.
Zinc roofing, 315.
Zipaquera in New Granada, salt works of, 89.

APPENDIX.

Notice of the Electro-Magnetic Machine of Mr. Thomas Davenport, of Brandon, near Rutland, Vermont.

Many years have passed since motion was first produced by galvanic power. The dry columns of De Luc and Zamboni caused the vibration of delicate pendulums and the ringing of small bells, for long periods of time, even several years, without intermission.

In 1819–20, Prof. Oersted, of Copenhagen, discovered, that magnetism was evolved between the poles of a galvanic battery. Prof. Sweigger, of Halle, Germany, by his galvanic multiplier, succeeded in rendering the power manifest, when the galvanic battery was nothing more than two small wires, one of copper and the other of zinc, immersed in as much acidulated water as was contained in a wine glass. The power thus evolved was made to pass through many convolutions of insulated wire, and was thus augmented so as to deflect the magnetic needle sometimes even 90°. Prof. Moll, of Utretcht, by winding insulated wire around soft iron, imparted to it prodigious magnetic power, so that a horse shoe bar, thus provided, and connected with a galvanic battery, would lift over one hundred pounds. About the same time, Mr. Joseph Henry, of Albany, now Prof. Henry, of Princeton College, by a new method of winding the wire, obtained an almost incredible magnetic force, lifting six or seven hundred pounds, with a pint or two of liquid and a battery of corresponding size; nor did he desist, until, a short time after, he lifted thousands of pounds, by a battery of larger size, but still very small, (1830.)

This gentleman was not slow to apply his skill to the generation of motion, and a successful attempt of his is recorded in this Journal, Vol. xx. p. 340. A power was thus applied to the movement of a machine, by a beam suspended in the center, which performed regular vibrations in the manner of a beam of a steam engine. This is the original application from which have sprung, or at least to which have succeeded, several similar attempts, both in this country and in Europe. A galvanic machine was reported to the British Association in 1835, by Mr. McGauly, of Ireland, and he has renewed his statements of successful experiments at the late meeting at Bristol. Mr. Sturgeon, of Woolwich, England, also reports a galvanic machine as being in use on his premises for pumping water, and for other mechanical purposes.*

But, I believe that Mr. Davenport, named at the head of this notice, has been more successful than any other person in the discovery† of a galvanic machine of great simplicity and efficiency. During the last two or three years, much has been said of this discovery in the newspapers, and it is probable, that in a future number of this Journal, drawings and an accurate description of the machine may be given. Having been recently invited to examine a working model, in two varieties of form, and to report the result, I shall now attempt nothing more than a general description, such as may render intelligible the account I am to give.

1. *The Rotary Machine, composed of revolving electro-magnets, with fixed permanent magnets.*

This machine was brought to New Haven March 16, 1837, by Mr. Israel Slade, of Troy, N. Y., and by him set in motion for my examination. The moving part is composed of two iron bars placed horizontally, and crossing each other at right angles. They are both five and a half inches long, and they are terminated at each end by a segment of a circle made of soft iron; these segments are each three inches long in the chord line, and their position, as they are suspended upon the ends of the iron bars, is horizontal.

This iron cross is sustained by a vertical axis, standing with its pivot in a socket, and admitting of easy rotation. The iron cross bars are wound with copper wire, covered by cotton, and they are made to form, at pleasure, a proper connexion with a small circular battery, made of concentric cylinders of copper and zinc, which can be immersed in a quart of acidulated water. Two semicircles of strongly magnetized steel form an entire circle, interrupted only at the two opposite poles, and within this circle, which lies horizontally, the galvanized iron cross moves in such a manner that its iron segments revolve parallel and very near to the magnetic circle, and in the same plane. Its axis at its upper end, is fitted by a horizontal cogwheel to another and larger vertical wheel, to whose horizontal axis,

* Sturgeon's Annals of Electricity, Magnetism, &c. No. 1, Vol. 1. October, 1836.

† Mr. Davenport appears to have been strictly the inventor of a method of applying galvanism to produce rotary motion.

weight is attached and raised by the winding of a rope. As soon as the small battery, destined to generate the power, is properly connected with the machine, and duly excited by diluted acid, the motion begins, by the horizontal movement of the iron cross, with its circular segments or flanges. By the galvanic connection, these crosses and their connected segments are magnetized, acquiring north and south polarity at their opposite ends, and being thus subjected to the attracting and repelling force of the circular fixed magnets, a rapid horizontal movement is produced, at the rate of two hundred to three hundred revolutions in a minute, when the small battery was used, and over six hundred with a calorimotor of large size. The rope was wound up with a weight of fourteen pounds attached, and twenty eight pounds were lifted from the floor. The movement is instantly stopped by breaking the connexion with the battery, and then reversed by simply interchanging the connexion of the wires of the battery with those of the machine, when it becomes equally rapid in the opposite direction.

The machine, as a philosophical instrument, operates with beautiful and surprising effect, and no reason can be discovered why the motion may not be indefinitely continued. It is easy to cause a very gradual flow of the impaired or exhausted acid liquor from, and of fresh acidulated water into, the receptacle of the battery, and whenever the metal of the latter is too much corroded to be any longer efficient, another battery may be instantly substituted, and that even before the connexion of the old battery is broken. As to the energy of the power, it becomes at once a most interesting inquiry, whether it admits of indefinite increase? To this inquiry it may be replied, that provided the magnetism of both the revolving cross and of the fixed circle can be indefinitely increased, then no reason appears why the energy of the power cannot also be indefinitely increased. Now, as magnets of the common kind, usually called permanent magnets, find their limits within, at most, the power of lifting a few hundred pounds, it is obvious that the revolving galvanic magnet must, in its efficiency, be limited, by its relation to the fixed magnet. But it is an important fact, discovered by experience, that the latter is soon impaired in its power by the influence of the revolving galvanic magnet, which is easily made to surpass it in energy, and thus, as it were, to overpower it. It is obvious, therefore, that the fixed magnet, as well as the revolving, ought to be magnetized by galvanism, and then there is every reason to believe that the relative equality of the two, and of course their relative energy, may be permanently supported, and even carried to an extent much greater than has been hitherto attained.

2. *Rotating Machine, composed entirely of electro-magnets, both in its fixed and revolving members.*

A machine of this construction has been, this day, March 29, 1837, exhibited to me by Mr. Thomas Davenport himself, who came from New York to New Haven for that purpose.

It is the same machine that has been already described, except that the exterior fixed circle is now composed entirely of electro-magnets.

The entire apparatus is therefore constructed of soft unmagnetic iron, which being properly wound with insulated copper wire, is magnetized in an instant, by the power of a very small battery.

The machine is indeed the identical one used before, except that the exterior circle of permanent magnets is removed and in its place is arranged a circle of soft iron, divided into two portions to form the poles.

These semicircles are made of hoop iron, one inch in width, and one eighth of an inch in thickness. They are wound with copper wire insulated by cotton—covering about ten inches in length on each semicircle and returning upon itself, by a double winding, so as to form two layers of wire, making on both semicircles about one thousand and five hundred inches.

The iron was not wound over the entire length, of one of the steel semicircles; but both ends were left projecting, and being turned inward, were made to conform to the bend of the other part, as in the annexed figure, which is intended to represent one of them; each end that is turned inward

and not wound is about one third of the length of the semicircle. These semicircles being thus fitted up, so as to become, at pleasure, galvanic magnets, were placed in the same machine that has been already described, and occupied the same place that the permanent steel magnets did before. The conducting wires were so arranged, that the same current that charged the magnets of the motive wheel, charged the stationary ones, placed around it, only one battery being used. It should be observed, that the stationary galvanic magnets thus substituted for the permanent steel ones, were only about half the weight of the steel magnets. This modification of the galvanic magnet, is not of course the best form for efficiency; this was used merely to try the principle, and this construction may be superseded by a different and more efficient one. But with this arrangement, and notwithstanding the imperfection of the mechanism of the machine—when the battery, requiring about one quart of diluted acid to immerse it, was attached, it lifted 16 lbs. very rapidly, and when the weight was removed, it performed more than 600 revolutions per minute.

So sensible was the machine to the magnetic power, that the immersion of the battery one inch into the acidulated water, was sufficient to give it rapid motion, which attained its maximum, when the battery was entirely immersed. It appeared to me that the machine had more energy with the electro-magnets, than with those that were permanent, for with the smallest battery, whose diameter was three inches and a half—its height five inches and a half, and the number of concentric cylinders three of copper and three of zinc, the instrument manifested as great power as it had done with the largest batteries, and even with a large calorimotor, when it was used with a permanent instead of a galvanic magnet. With the small battery and with none but electro or galvanic magnets, it revolved with so much energy as to produce a brisk breeze, and powerfully to shake a large table on which the apparatus stood.

Although the magnetization of both the stationary and revolving magnets was imparted by one and the same battery, the magnetic power was not immediately destroyed by breaking the connexion between the battery and the stationary magnet; for, when this was done, the machine still performed its revolutions with great, although diminished energy; in practice this might be important, as it would give time to make changes in the apparatus, without stopping the movement of the machine.

It has been stated by Dr. Ritchie, in a late number* of the London and Edinb. Phil. Magazine, that electro-magnets do not attract at so great a distance as permanent ones, and therefore are not well adapted for producing motion. On this point Mr. Davenport made the following experiment, of which I was not a witness, but to which I give full credit, as it was reported to me by Mr. Slade, in a letter dated New York, March 24, 1837.

Mr. Davenport suspended a piece of soft iron with a long piece of twine, and brought one pole of a highly charged steel magnet

* January, 1837.

within the attracting distance, that is, the distance at which the iron was attracted to the magnet; by measurement, it was found that the steel magnet attracted the iron one inch and one fourth. A galvanic magnet was next used of the same lifting power, and consequently of much less weight; the attracting distance of this magnet was found to be one inch and three fourths, shewing a material gain in favor of the galvanic magnet. Mr. Slade inquires, "has Mr. Ritchie's magnet been so constructed as to give a favorable trial to this principle?"* Mr. Davenport informs me that each increase in the number of wires has been attended with an increase of power.

Conclusions.

1. It appears then, from the facts stated above, that electro-magnetism is quite adequate to the generation of rotary motion.

2. That it is not necessary to employ permanent magnets in any part of the construction, and that electro-magnets are far preferable, not only for the moving but for the stationary parts of the machine.

3. That the power generated by electro-magnetism may be indefinitely prolonged, since, for exhausted acids, and corroded metals, fresh acids and batteries, kept always in readiness, may be substituted, even without stopping the movement.

4. That the power may be increased beyond any limit hitherto attained, and probably beyond any which can be *with certainty* assigned,—since, by increasing all the members of the apparatus, due reference being had to the relative proportionate weight, size, and form of the fixed and movable parts—to the length of the insulated wires and the manner of winding them—and to the proper size and construction of the battery, as well as to the nature and strength of the acid or other exciting agent, and the manner of connecting the battery with the machine, it would appear certain, that the power must be increased in some ratio which experience must ascertain.

5. As electro-magnetism has been experimentally proved to be sufficient to raise and sustain several thousands of pounds, no reason can be discovered why, when the acting surfaces are, by skillful mechanism, brought as near as possible, without contact, the continued exertion of the power should not generate a continued rotary move-

---

* This question I am not able to answer, as I have not seen any account of the apparatus or of the experiment, but only of the result.

ment, of a degree of energy inferior indeed to that exerted in actual contact, but still nearly approximating to it.

6. As the power can be generated cheaply and certainly—as it can be continued indefinitely—as it has been very greatly increased by very simple means—as we have no knowledge of its limit, and may therefore presume on an indefinite augmentation of its energy, it is much to be desired, that the investigation should be prosecuted with zeal, *aided by correct scientific knowledge*, by *mechanical skill*, and by *ample funds*. It may therefore be reasonably hoped, that science and art, the handmaids of discovery, will both receive from this interesting research, a liberal reward.

Science has thus, most unexpectedly, placed in our hands a new power of great but unknown energy.

It does not evoke the winds from their caverns; nor give wings to water by the urgency of heat; nor drive to exhaustion the muscular power of animals; nor operate by complicated mechanism; nor accumulate hydraulic force by damming the vexed torrents; nor summon any other form of gravitating force; but, by the simplest means—the mere contact of metallic surfaces of small extent, with feeble chemical agents, a power every where diffused through nature, but generally concealed from our senses, is mysteriously evolved, and by circulation in insulated wires, it is still more mysteriously augmented, a thousand and a thousand fold, until it breaks forth with incredible energy; there is no appreciable interval between its first evolution and its full maturity, and the infant starts up a giant.

Nothing since the discovery of gravitation and of the structure of the celestial systems, is so wonderful as the power evolved by galvanism; whether we contemplate it in the muscular convulsions of animals, the chemical decompositions, the solar brightness of the galvanic light, the dissipating consuming heat, and, more than all, in the magnetic energy, which leaves far behind all previous artificial accumulations of this power, and reveals, as there is full reason to believe, the grand secret of terrestrial magnetism itself.

B. S.

New Haven, March 31, 1837.

Claim of Thomas Davenport.

In the words of the patent, taken out, this invention "consists in applying magnetic and electro-magnetic power as a moving principle for machinery, in the manner described, or in any other substantially the same in principle."

"Mr. Davenport first saw a galvanic magnet in December, 1833, and from the wonderful effects produced by suspending a magnet of 150 lbs. from a small galvanic battery, he immediately inferred, without any knowledge of the theory or the experiments of others, that he could propel machinery by galvanic magnetism. He purchased the magnet and produced his first rotary motion in July, 1834. In July, 1835, he submitted his machine to Prof. Henry, of Princeton, New Jersey, also without any knowledge of Prof. Henry's experiments in producing a vibratory motion. From this gentleman he received a certificate, testifying to the originality and importance of the invention."

Mr. Davenport is, by occupation, a blacksmith, with only a common education, but with uncommon intelligence; his age about thirty five. Mr. Ransom Cook, of Saratoga Springs, is associated with Mr. Davenport, and has rendered essential service by the improvements he has made in the machine, and by his assistance in bringing the subject before the public in the most effectual way. Arrangements have been made to take out the patent in Europe.

P. S. The proprietors are constructing a machine of seven inches in diameter, and also one of two feet in diameter. Galvanic magnets will be used as the moving and stationary magnets of each.

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 and pamphlets 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 me, that I may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still my 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, as now, in part, retrospective.—*Ed.*

DOMESTIC.

An Address before the Law Association of the City of New York, by the Hon. James Kent. Two copies; one from the Author, the other from B. D. Silliman, Esq.

Report on a Geological Survey of the State of Ohio. Three copies, from Mr. Seabury Ford, R. Granger, Esq. and Dr. S. P. Hildreth.

Lecture before the Law Class of Transylvania University, by Geo. Robertson, LL. D. From J. G. Martin, Esq.

A Friend to the South. Boston, 1836.

Letter of Rev. Wm. E. Channing to James G. Birney. Author.

Essay on the influence of Tobacco upon life and health; by R. D. Mussey, M. D. Boston, 1836. From the Author.

A Catalogue of Plants and Shells, found near Milwaukee, on the shores of Lake Michigan; by J. A. Lapham. Two copies, one for Yale Nat. Hist. Society; from the author.

Address before the Alumni of Hanover College, Indiana; by M. A. H. Niles, A. M. From Prof. W. M. Dunn.

Providence Daily Journal, Vol. VIII, No. 141.

Connecticut Courant, Vol. IV, No. 50.

The Specie Circular—Speech of Mr. Webster, (of Mass.) From Hon. Abbott Lawrence.

Catalogue of Willoughby University, Lake Erie, Circular No. 4.

Catalogue of the Faculty and Students in the Medical School at Fairfield, Herkimer County, N. Y. 1836-37. From Dr. Mussey.

Catalogue of Books for 1837, chiefly published or imported by Hilliard, Gray & Co. Boston; from them.

Journal of the American Temperance Union, Nos. 1 and 2.

Temperance Recorder, No. 1.

A Compendium of Chemistry; by Robert Hare, M.D. Prof. of Chemistry, Univ. Penn. Third edition. From the Author.

Catalogue of Oberlin Institute, 1836-37.

First Annual Report of the Pennsylvania State Geologist. Two copies, from H. R. Trego, Esq. and E. Chauncey, Esq.

The Anti-Slavery Record, Vol. III. No. 1. E. Wright, Editor.

Correspondence of the American Bible Society, No. 7. From the Editor.

An Elementary Treatise on Astronomy, by John Gummere, A.M. Philadelphia, 1837. From the Author.

Mr. Cushing's Oration before the literary societies of Amherst College. From Mr. C. F. Smith.

Daily Buffalo Journal, with notices of the aurora and magnetism, Dec. 5, and Jan. 27 and 30, 1837. Mr. Haskins.

Boston Daily Advertiser, Vol. 42, Nos. 13,900 and 13,908, with notices of floating pumice stone on the coast of California.

New England Spectator, Boston, Vol. iii. No. 2. E. Thorp.

Gambier Observer, Vol. vii. No. 4.

Mr. Featherstonhaugh's Geological Report from Washington, by Green Bay and the Wisconsin Territory, to the Coteau de Prairie, &c. Two copies, one from Hon. S. Fowler, M. C. the other from Col. Abert.

Hints on the cultivation of the Mulberry, with some general observations on the production of Silk, by Lewis Tinelli, LL. D., C. L. Pavia, &c. The Author.

First Report on the Geological Survey of New York. Four copies, one to Am. Geol. Soc. one to Y. Col. Nat. Hist. Society. To the Editor, by E. Emmons, W. W. Mather and E. Briggs.

Another copy, from H. W. Taylor.

Report of Hon. Henry Clay on the address of certain British, and the petition of certain American authors on copyright. Hon. G. Tomlinson, S. U. States.

The Alabama Reporter, Vol. i. Nos. 4 and 5.

Columbia Telescope, Vol. xxiii. No. 7. From E. Adams, jr.

Genesee Farmer, Vol. vii. No. 5. Dr. Marsh, with meteorological observations.

Project and Act for a Statistical Society in New York. Ed. Williams.

Catalogue of the Medical College of S. C. Prof. C. U. Shepard.

Account of Saml. Raub, Jr.'s safety apparatus for steam boilers. Hon. G. Tomlinson, S. U. States.

Fourth Annual Report of the Trustees of the State Lunatic Hospital at Worcester. From the Superintendent, Dr. S. B. Woodward.

American Advocate of Peace, Hartford, Dec. 1836. F. Fellows, Editor.

Letter to Hon. W. H. Smith on School District Libraries, Genesee, 1837.

Laws of the University of Nashville, Tenn.

Catalogue of Indiana Theological Seminary and Hanover College, 1836-7. Prof. Dunn.

Jewett's Advertiser, Vol. ii. No. 10, and Vol. iii. No. 1 and 2. The Editor.

Milwaukee Advertiser, Vol. i. No. 29, with a map and notice of an ancient city in the Wisconsin Territory. J. A. Lapham.

The same in a Springfield paper, Illinois. J. W. Beach, Nashville, Illinois.

5th Annual Report of the Trustees of the New England Institution for the education of the blind—Boston, 1837. Dr. Saml. G. Howe.

Report of John L. Riddell, M. D. on a Geological Survey of Ohio. The Author.

Dr. Robley Dunglison's Address to the Medical Graduates of the Jefferson Medical College. The Author.

A second copy, from an unknown hand.

Annual Report of the Common Schools, Academies and Colleges of Pennsylvania, by Th. H. Burrowes, Superintendent.

First Report on the Geology of Maine, with an atlas of plates, by Dr. Charles T. Jackson. Two copies. The Author.

Summary of Meteorological Observations—last half of 1836—Lexington, Ky. By Dr. Robert Peters. The Author.

The Juvenile Lyceum, New Brunswick, N. J. Vol. i. Nos. 10 and 11.

FOREIGN.

Brighton Gazette and Lewes Observer. Nos. 822 and 825. From Dr. Mantell, Eng.

Brighton Herald, No. 1574, Feb. 18, 1837. The same.

Report addressed by the Royal Soc. of Northern Antiquaries to its British and American members. Copenhagen, 1836.

Annals of Electricity, Magnetism and Chemistry, conducted by William Sturgeon. London. Vol. i. No. 1, 1836. Oct. From the Author.

Researches on Heat. 2d series, 4to. By Prof. J. D. Forbes, Edinb. 1836. The Author.

On the application of Glass for metal balance springs in chronometers. From Messrs. Arnold & Dent, London.

Neues Jahrbuch sur Mineralogie, Geognosie, &c. 3 Nos. 1836. Prof. Leonhard & Bronn, Heidelberg, Germany.

A descriptive Catalogue of the Mantellian Museum, Brighton, Eng. 4th ed. 1836. Three copies. From Dr. Mantell.

Thoughts on a Pebble. London, 1836. Two copies. From Mr. W. B. D. Mantell.

Essay on the German Language and Literature. By G. F. Richardson, Esq. Brighton, Eng. From the Author.

A Letter to the School Masters and Governesses of England and Wales. By Sir Richard Phillips. London. From Dr. Mantell.

New Works and New Editions. Messrs. Longman & Co.

Proceedings of the Geol. Soc. of London. Vol. ii. No. 41. The Society.

Phillips' Aphorisms—a century of original ones.

The Mining Journal, &c. No. 63 to 71. Vol. iii. inclusive.

The same, No. 72 to 75, Vol. iv. The Editor.

Conjectures on the future effects of Locomotion by Steam. By Horace Smith, Esq. From Dr. G. Mantell.

Geology and Natural History of the Province of Kemaon, Calcutta, Bengal, 1835. By Asst. Surgeon McLelland. From the Author, through Otis, Broaders & Co. Boston, U. S.

L'Institut, Paris, Nos. 185 to 195 inclusive. 25th Nov. to Feb. 1837.

Bibliotheque Universelle, Geneva. No. 10. Oct. 1836.

Bulletin de la Société Geologique de France.

Tome vi. last part, feuilles 21—23.

Tome vii. three parts, feuilles 8 to 19. From the Society.

Annales de Chimie et de Physique. August and September, 1836.

THE AMERICAN JOURNAL, &c.—AGENTS.

MAINE.
SACO, Rufus Nichols.
PORTLAND, Colman, Holden, & Co.
VERMONT.
BRATTLEBORO', G. H. Peck.
NEWHAMPSHIRE.
Dart. Coll. HANOVER, Prof. Oliver P. Hubbard.
MASSACHUSETTS.
NEWBURYPORT, Charles Whipple.
NANTUCKET, John F. Macy,
SALEM, Henry Whipple.
NEW BEDFORD, William C. Taber.
SPRINGFIELD, G. & C. Merriam.
NORTHAMPTON, S. Butler & Sons.
AMHERST, J. S. & C. Adams.
WORCESTER, Dorr, Howland, & Co. Clarendon Harris.
LOWELL, D. Bixby.
RHODE ISLAND.
PROVIDENCE, B. Cranston & Co.
CONNECTICUT.
HARTFORD, Canfield & Robbins.
NORWICH, Thomas Robinson.
MIDDLETOWN, Luke C. Lyman.
NEW YORK.
NEW YORK, A. T. Goodrich.
WEST POINT, John DeWitt.
NEWBURGH, H. P. Benham.
ALBANY, W. C. Little.
TROY, Wm. S. Parker & Son.
FORTVILLE, N. A. Angle.
ITHACA, D. D. Spencer.
CANANDAIGUA, Morse & Harvey.
AUBURN, L. Briggs.
ROCHESTER, Hoyt, Porter & Co.
BUFFALO, O. G. Steele & Co.

NEW JERSEY.
NEW BRUNSWICK, Terhune & Letson.
PENNSYLVANIA.
PITTSBURGH, John J. Kay & Co.
MARYLAND.
BALTIMORE, E. J. Coale & Co.
DISTRICT OF COLUMBIA.
WASHINGTON, Kennedy & Elliott.
NORTH CAROLINA.
CHAPEL-HILL, Prof. E. Mitchell.
SOUTH CAROLINA.
COLUMBIA, B. D. Plant.
CHARLESTON, John P. Beile.
VIRGINIA.
RICHMOND, R. I. Smith & Co.
WHEELING, J. Fisher & Sons.
ILLINOIS.
PEORIA, Silas W. Robbins.
OHIO.
COLUMBUS, I. N. Whiting.
GEORGIA.
SAVANNAH, Wm. T. Williams.
AUGUSTA, Th. I. Wray.
TENNESSEE.
NASHVILLE, Wm. A. Eichbaum.
MEMPHIS, Fowlkes & Pugh.
ALABAMA.
HUNTSVILLE, Irby & Smith.
MOBILE, Woodruff, Fiske & McGuire.
MISSISSIPPI.
GRAND GULF, Wm. M. Smyth.
CANADA.
QUEBEC, Samuel Neilson.
MONTREAL, Armour & Ramsay.
GREAT BRITAIN.
LONDON, James S. Hodson, No. 112 [Fleet St.
FRANCE.
PARIS, Chas. Duperron, *Rue Mabillon.*

TERMS.

Six dollars per annum; published in four Quarterly numbers, making two volumes a year, of from eight to nine hundred pages for both volumes, which are fully illustrated by plates.

☞Terms of credit to general agents, six months from the publication of No. 1, of each volume.

The Editor will draw on the agents, semi-annually, i. e. *on the publication of No.* 2 *of each Vol., payable, April* 1, *and October* 1, *in all cases, where payment is not otherwise provided for.*

Complete sets, now 31 vols., are furnished at a suitable discount.

The price of this Journal, on account of a limited patronage, *of numerous plates*, and *the frequent extra expense of difficult composition*, is, necessarily, more than that of the quarterly Literary Reviews. At five dollars, it would not pay for the *materiel* and the mechanical labor, especially as frequent reprints of Nos. are necessary to furnish complete sets.

TO CORRESPONDENTS.

The titles of communications and of their authors, to be fully given.
When extra copies are desired, the notice should be placed at the head of the MS.
Notice always to be sent of discontinuance, removals and deaths of subscribers.
Return proofs, not to be sealed, or inscribed with any thing except corrections.
No pages to be left blank in MS. communications sent by mail.
Several communications for the present No., are necessarily deferred.

THE

THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and For. Mem. Geol. Soc., London; Mem. Geol. Soc., Paris; Mem. Roy. Min. Soc., Dresden; Nat. Hist. Soc., Halle; Imp. Agric. Soc., Moscow; Hon. Mem. Lin. Soc., Paris; Nat. Hist. Soc. Belfast, Ire.; Phil. and Lit. Soc. Bristol, Eng.; Hon. Mem. Roy. Sussex Inst. Brighton, Eng.; Lit. and Hist. Soc., Quebec; Mem. of various Lit. and Scien. Soc. in America.

VOL. XXXII.—No. 1.—APRIL, 1837.

FOR JANUARY, FEBRUARY, AND MARCH, 1837.

NEW HAVEN:

Sold by A. H. MALTBY and HERRICK & NOYES.—*Baltimore*, I. SMITH HOMANS, (late E. J. Coale & Co.)—*Philadelphia*, CAREY & HART and J. S. LITTELL.—*New York*, G. & C. CARVILL & Co., No. 73 Cedar St., and G. S. SILLIMAN, No. 45 William St.—*Boston*, HILLIARD, GRAY & Co.

PRINTED BY B. L. HAMLEN.

THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and For. Mem. Geol. Soc., London; Mem. Geol. Soc., Paris; Mem. Roy. Min. Soc., Dresden; Nat. Hist. Soc., Halle; Imp. Agric. Soc., Moscow; Hon. Mem. Lin. Soc., Paris; Nat. Hist. Soc. Belfast, Ire.; Phil. and Lit. Soc. Bristol, Eng; Hon. Mem. Roy. Sussex Inst. Brighton, Eng.; Lit. and Hist. Soc., Quebec; Mem. of various Lit. and Scien. Soc. in America.

VOL. XXXII.—No. 2.—JULY, 1837.

FOR APRIL, MAY, AND JUNE, 1837.

NEW HAVEN:

Sold by A. H. MALTBY and HERRICK & NOYES.—*Baltimore*, I. SMITH HOMANS, (late E. J. Coale & Co.)—*Philadelphia*, CAREY & HART and J. S. LITTELL.—*New York*, G. & C. CARVILL & Co., No. 73 Cedar St., and G. S. SILLIMAN, No. 45 William St.—*Boston*, HILLIARD, GRAY & Co.

PRINTED BY B. L. HAMLEN.